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PHILOSOPHY FROM AN AGRICULTURIST[1]

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Mr. Chairman and gentlemen:

I wish, at the outset, to express my appreciation of the kindly courtesy on the part of the O.A.C. Alumnae and the C.S.T.A. in asking me once more to be the guest speaker at their annual banquet. I am sincerely sorry that our University President, Dr. R. C. Wallace, was unable to accept your invitation to be your speaker at this event and he asked me to convey to you his regrets, also his greetings and best wishes. I wish to offer my regrets because I would much prefer to have our President speak to you this evening. We are rather proud of our President. However, even if I am an after-thought, I am consoled by the fact that another great person in the world's history was only an after-thought. I refer to Mother Eve.

At the outset also, I should like to pay my tribute once more to that great organization, the C.S.T.A., and more particularly to-night to your Locals represented here. My now almost patriarchal connection with the C.S.T.A. renders it unnecessary for me to more than mention the Society in passing. When I pay my tribute to the O.A.C. I wish again to emphasize my deep sense of gratitude to that institution not only for the impetus it gave me in my life's work but perhaps chiefly because of the happy hours I spent on College Heights and the many friends made at that time—the kind of friends that stick by you. In that connection I want to mention the class of 1911, which in spite of possible contradiction, I do maintain was and is the outstanding year in the class history of the College. Take a look over what its graduates are doing to-day if you doubt my statement.

I am planning this evening, with your kind tolerance, to indulge in some homely philosophy, if one may use so ambitious a term, in regard to western agriculture and agriculturists. I have in vivid recollection the splendid address given by Dr. Barton a few years ago in which he dealt intimately with the educational side of agriculture. I trust he will not forget what he then said now that he has gone to that "seat of iniquity" at Ottawa. I understand that Dean Shaw two years ago talked to you about certain agricultural conditions in the West. He and I are rather close together, geographically and otherwise, and I am probably in accord with all that he said, but I wish to avoid covering any part of the same field. In my talk to-night I shall have in mind our people and shall mention conditions and problems only as they affect our people as they "live, move and have their being".

It is inevitable that in all that I have to say with regard to western conditions and people, I shall have in the foreground of my thoughts the young

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[1] Address delivered at the annual Ontario O.A.C. Alumni Association—C.S.T.A. Banquet, Royal York Hotel, Toronto, Friday, November 24, 1933.

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people. As a matter of hard fact we older people are not nearly as important as we try to make ourselves believe. Our wisdom and foresight, developed by years of experience, are only important in so far as we use them to shape better facilities for those who are coming after us to do our work just a little better than our performances indicate. That is our great privilege.

I submit that if we are going to exert the influence just indicated we must devote ourselves to the task of showing the young and coming agriculturists that there is still a vital challenge in agriculture. It may be true that the day of the sod hut in the West is gone; that the work of the range is more and more shaping itself along less picturesque lines; that the Indian has largely disappeared and anyway does not represent thrill and adventure any more. Indeed, many of the things that took our young people West, challenges of adventure, if you please, no longer beckon. I want, however, to indicate in the West a definite challenge to those who are up and coming in the youth of the land, a challenge which will call for all of the fortitude, all of the vision and all of the action which we have ascribed in the past to pioneers, and I really think that we should try to present these fields of possible activity in a way that shall indicate the fact that there are still many dragons to conquer, wrongs to redress and romantic episodes in the offing if they will only look for these things. And now, having indicated the spirit in which I wisn to consider the problems before us, I shall offer my brief homely comments upon some of the fields that are challenging us in our building up a country which we have "overrun but not yet occupied".

I. Agricultural Economics

I take this first because I know least about it and not many of you know much more. Perhaps you will say "surely there are enough talking in this field at present"; and I would say, "more than enough". I am certainly not pleading for more people to air their views in regard to our economics. I am really going to plead for a smaller number who shall take a much longer time in which to inform themselves. This is not peculiarly a western problem I notice and indeed some of your eastern authorities are apparently ready to settle the question for us quite promptly.

Of course I do not refer to the great body of the people, who, undoubtedly, should take an intelligent interest in the economic factors that affect their lives, but when it comes to special diagnoses there are not so many running loose in Canada who are competent to pass expert judgment in regard to our economic problems. Let me add that I am always pleading for more study and less talk. I am sure you will recognize the great field for work in agricultural economics in Eastern Canada as well as Western, so I will not labour the question.

I have voiced my confession of faith because I am tired to death of the demagogic soap-box specialist in this day when we have enough real trouble. We have no right to demand infallibility, but we certainly have a right to be delivered from quackery, and to this end I would earnestly advocate that there should be a constant seeking after the few who are so mentally endowed that it is worth their while, and worth the while of their fellow men, that they shall be given every opportunity to become high-class specialists in dealing with problems that you and I have not the time and training to diagnose.

In connection with the foregoing comment I should like to record my satisfaction and encouragement in the step taken by the management of *Scientific Agriculture* as indicated in the October issue. Here is presented quarterly, *The Economic Annalist*, a review of agricultural business. Then too, monthly, will be furnished statistical material that should be of outstanding importance to all of us who are interested in technical agriculture. In doing this *Scientific Agriculture* is performing a valuable and timely service.

II. Co-operation

In this case I am approaching the subject with a certain hesitancy. The term co-operation has been tossed about from one to another and in some cases has so developed into a sort of verbal band-wagon, that it is only a sense of duty that makes me feel like offering my contribution.

Let me say at the outset that I firmly believe in co-operation, but if you come right back at me and ask me what I mean by co-operation, I shall pick my words very carefully. Four or five years ago, in my first C.S.T.A. report on Agricultural Policies, I stated "co-operation is an over-worked term for for a sometimes nebulous idea". It is quite probable that I was too severe in my criticism, but I still maintain that I defined something that was well worth thinking about. I mean that one can use a term in such a glib and off-hand way that we can render it meaningless by too much repetition. In the second place, I think I was correct in saying that a lot of the people who talked about co-operation had rather ill-formed ideas about the scope and possibilities of the principle they were discussing.

Now, I am not going to talk about certain factors of co-operative effort in our West that have attracted the attention of the world. I am not going to discuss with you the status of the several pools, nor shall I discuss particularly the matter of purchasing agencies. I am well aware that I am talking to an audience with mixed opinions and your opinion is just as good as my own. I want to discuss the problem from an angle that is not so very often recognized. Even supposing our pools and our central purchasing agencies were functioning to perfection, or even if they had all failed, either case would not affect the argument I wish to bring forth.

To me co-operation is a spirit. In some countries it would be hailed almost as a religion. It is of the heart as well as of the head, and therein lies the grand opportunity for the young people who are going out in the next decade to face the world. I am hoping that some of our young knights, going out to do worthy deeds, will see in this great field of co-operative effort, a chance to leave their mark on Time's record.

Co-operative effort presupposes a pooling of effort, at times, of resources, and the pooling of thought, and this presupposes that the individuals so co-operating have each something to contribute to this pool, and I do not mean wheat pool or any special institution. Therein lies one of our great difficulties. Suppose we have two farmers living side by side under fairly similar conditions of climate and soil. You know as well as I do that one of them may show evidences of thrift, of culture, of happiness, while it is possible that his neighbor will fall far short of showing these evidences. I leave it to you to say which of these two would shout the louder for co-operation if some pooling of effort were under discussion. I submit that it would be the man who had the least to pool. This is not a condemnation of co-operation,

but indicates one of its difficulties. However, that is not my main point. What I wish to propose to you is that often when we in the West have been advocating co-operation, what we sometimes had in mind was the effect of co-operation rather than the foundational causes.

I wish to say, in all seriousness, that it is my contention that co-operative effort based only on a knowledge of the alleged mechanics of co-operation, or based upon the desire for personal gain, is starting off with a tremendous handicap. It is my contention also that co-operative effort should be a builder of character and, as well, an evidence of character. So I say that we cannot begin too soon in our educational institutions to quietly and in a simple way build up a concept, on the part of the young people, that co-operation means individuals working together for the good of the whole body of our people, with a sense that the highest ideal is, " What can I contribute? " not, "What can I get out of this?". I am not at all making light of the mechanics of co-operation, of co-operative buying and selling agencies, because if the proper spirit and character is there, the very pooling of efforts and resources is bound to find its implement in some such way. But again I say that these are the effects and not the causes, nor necessarily always inspired by the spirit of co-operation. What I am trying to emphasize is that co-operation is a vastly greater thing than a group of farmers, or a group of labourers, or a group of commercial men, banding together to secure cheaper purchase or higher prices. This in itself may be effort worth while, but again I say that unless it is based upon unselfishness, upon thought for the other fellow, it is running a very fair chance, even in a material sense, of failure to accomplish that which was intended.

III. Production and Marketing

How often one has heard during the past few years, the statement "we have solved the problems of production but we have paid little or no attention to the problems of marketing". Every time I have had the opportunity I have raised my voice in protest against this sweeping statement simply because it is not according to fact. That we have not paid enough attention to the machinery of marketing, I am quite ready to agree; also that one of our major enterprises should always be the proper distribution of our products; but when people say that we have solved the problems of production, I must take exception in no uncertain terms. The fact of the matter is that we, in this far-flung country of ours, are mere children in the matter of production. If there has been over-production quite recently, and this is still regarded as debatable, it is absolutely no proof that we have solved the problems of production. Moreover, it must not be forgotten that production is an integral part of a sound marketing system and cannot be so divorced. They are as inseparable as Mutt and Jeff, or ham and eggs,—indeed more so.

I said at a C.S.T.A. Convention, as far as I can recollect, "If we can train our people to produce the right thing at the right time and in the right way, we shall have taken care of the biggest problem in marketing". You may think that this is an extreme statement, but it was made after long and careful thought and is not in the least intended to minimize the importance of a study of the machinery of marketing. Let us analyze my statement. Have we always produced the right product? The answer is most emphatically, "No!" Was the great concentration on wheat all over the West producing the

right product? Not in some districts, by a big margin. Speaking of wheat again, was it produced at the right time? Again, not always, or the quality would have been better. Perhaps we did our best in so far as we had light. Was it produced in the right way? Not altogether, when we consider the multiplicity of varieties that have flooded the market in recent years, inevitably detrimental to the quality of our product, and quality is the one asset on which we have to bank in a world-wide striving for wheat markets. I might also add that there were areas broken to wheat that should, by all means, have been left to grass, and there were areas cut by combine that should not have been so handled.

When we come to the realm of livestock products we have still less to show for our work in producing the right product at the right time and in the right way. I must not labour the question further at this time, but I hope people will think it over seriously, each in terms of his own locality.

IV. Mechanization

Some years ago—not so very many—I took a ride in the first automobile that came to the city of Ottawa. Five of us with more money than judgment, and not much of either, chartered this famous machine, along with its driver, to take us to the Fair at Richmond, some twenty miles distant. The machine had a dash-board like the buggy—there may even have been a whip socket. At any rate, except for the driving wheel, the front part was built after the style of the old phaeton. The large section was arranged like the hotel bus, with two longitudinal seats facing each other and the passengers entered from the rear by using a set of bus steps. Over the top was a square cover, again like the old phaeton top, and there was no side protection. The drive wheels were propelled by an outside chain drive, after the manner of the bicycle.

As we groaned and ground our way over the macadamized road, we could not keep out of our own dust and all the dogs in the country turned out to bark at us. When we reached the fair ground we excited more active attention than is accorded the flying machine to-day. The fair management asked us to drive around the race-track. We drove around two or three times before all of the people, crowded on wagons, fence rails, grandstand and wherever a place of vantage was obtainable. I elected to ride on the step at the back of the car and in making the circuit I harangued the crowd, as I distinctly remember, to the effect that they were looking at something that was going to change the whole world for us. Had I died that day I should surely have been put in the same box-stall as the prophets.

That was twenty-eight years ago this fall. If anyone that day had ventured to whisper even a suggestion of the change that has taken place in that period, he would have been met with pity; yet the crude machine in which we rode was the beginning of something that was to greatly influence our civilization.

The foregoing reminiscent paragraphs are simply introductory in their intent. Twenty-eight years is quite a space in one man's life, but what an infinitesimal fraction in the life of the race! It is not my intention to dwell on the evolution of the automobile, important and far-reaching as the story would necessarily be, but to deal with another phase of the great change in

our civilization; a change that was heralded by the advent of the automobile; I refer to the mechanization of the agricultural life of our people.

In a few years the driving horse has practically disappeared from the farms of our country, not because the older people willed it, but because the younger, and to a lesser extent the older people, having once experienced the speed of the automobile, were not to be easily reconciled to the comparatively plodding movement of the driving horse. Yet the old horse and buggy had its day and in bidding it good-bye let us do it the justice to record the interrogation, "Are the people happier than they were twenty-five years ago?" The young people of to-day need not feel any sense of superiority; the only difference is that the driver sits on the left-hand side of the vehicle now, and the prevalent parked automobile on a summer night is only the present-day manifestation of the old way of a man with a maid, when in another age the driver simply wrapped the reins around the whip stock and a properly trained horse did not need to be parked.

With the adoption of the automobile by the younger generation it was inevitable that these younger fellows should become machine-conscious rather than horse-conscious. Concurrently with this change, tractors were emerging from the steam age to the age of gasoline. It needs no stretch of the imagination to indicate how the farm boy just naturally took to the handling of a tractor, being used to the problems involved in the gasoline engine.

Now, there are probably some of you here who have heard my confession of faith in regard to the place of farm mechanization, or perhaps you have read it, because I have spoken in no uncertain terms at many meetings, and my talks were somewhat widely printed. In a word, I have pleaded for a sane analysis in regard to the place of new inventions in our farm practices. I think I was guarded about making sweeping statements because of the great variety of conditions existing in our West, but I have been somewhat concerned that so many speakers and writers (strange to say many of these came from the East) were bound to drive us into some rather indefinite grandiose scheme of mammoth farming that would have as its object growing wheat at a minimum cost per bushel, with a great lessening of labour and the days would all be sunny. Right here I would like to interject a statement that part of my impatience is due to a realization of the fact that the farmer is over-advised. If I allowed myself, I should probably speak with some heat about the number of untrained men who feel that they can advise in regard to the technique of agriculture. It is hardly fair, when we train men for this purpose, that the landscape should be cluttered up with this type of adviser, who has at least one gift—that he is able to attract attention.

I note that there has been a tendency to sneer because there has been a reaction toward diversified farming and it is pointed out, quite truthfully, that livestock is also low in the market at the present time, therefore, "Why advocate livestock?" Well, I should like to point out that the very strong reaction toward the raising of livestock in most of the areas in the West has not been with the idea of making some quick money but because in and with that type of effort lies a reaction toward providing reasonable main-

tenance upon the farm. I should like to suggest that probably very little of this swing back to livestock was due to advice from the outside.

Before leaving this topic I should like to submit that in a large part of our West the farmers should seriously ponder whether the saving of a little labour will justify their doing away altogether with horses. I may be a little prejudiced in the matter, but the fact remains that a very large number of farmers have, under present conditions, returned to the use of horses, for reasons which are obvious, and there is not a doubt that the farmer who had the odd horse on the premises lately very often considered himself as lucky. Frankly, in many areas in our West the ideal situation would be the employment of both the horse and mechanical power, one being the complement of the other; he who advocates the opposite is either decidedly an enthusiast for the mechanical age or perhaps is just a band-wagon addict who will have some other slogan shortly.

V. Sweeping Statements

I hope that the young man of the next decade will not be given to sweeping statements. To thoughtful men it must appear that in the West we have been great sinners in this respect, or the cause of great sinning at least. I am not going to speak of this as it affects politics or economics, but I would like to confine myself to its relation to farm practices. Let me use a concrete example and you can apply the particular as you will. How often have we heard and read within the last three years, a solution, or solutions, of our soil difficulties? It has been done: "In the West they should do this", or "In Saskatchewan they should do something else". Now in all common sense how can any man in dealing with this far-flung country of ours, attempt to lay down a rule? Here I am speaking about something of which I am confident. Beginning somewhere about 1919 we began a thorough-going, systematic soil survey of the province of Alberta. Following the blocks marked out by the Dominion Department of Interior, we took a certain sheet each year. This was thoroughly surveyed by men who knew their job. Maps were built up from the findings and observations; a map for each sheet and a report for each sheet surveyed to date was printed. We began our work in the southern part of the province, covering the MacLeod Sheet, Medicine Hat Sheet and others. Then, due to the fact that so much attention was being attracted to the North, and later due to the fact of the possibility, or probability, of our taking over our natural resources, our field gangs were switched to the north country. That is all the explanation I need give. What I want to say is that anyone among you who would examine our maps to-day, would be impressed, first of all, with the tremendous variation in the soil conditions obtaining in large districts. He who would examine these must come away firmly convinced that any sweeping statement as to soil conditions of the Province of Alberta is ridiculous and presumptuous.

VI. The In-and-Outer

The young farmer of tomorrow will, I hope, have ceased to be an in-and-outer. You know what I mean—a man who, when pork is high, rushes into pigs, and then when the horizon is darkened with pigs and the price is going down, is anxiously looking for some other chance to plunge. If wheat is high, he breaks up land that should be in pasture and that should never have

been broken perhaps, and then when the wheat market slumps, well, he is ready to try something else. That man is not a farmer; he is only masquerading as one. I hope that the hypothetical young man that we are considering will save and invest soundly his profit when prices are good and that he will know better than to throw up his hands and quit because prices have gone down.

VII. The So-Called Foreigner

A great problem in the West is the assimilation of the so-called foreign peoples in a way that should be best for the future of that part of Canada. I am not at all pessimistic about the possibilities in this field. We have in our University many of the children of immigrants, and their record is one of which they well may be proud. A great body of these people are generally spoken of as Ukrainians and they have brought to the West an industry and thrift which the rest of us might well strive to imitate. They have brought to us also their own culture as exemplified in their handicraft and their music. I have very grave doubts as to whether you and I, if transported to a new country, could show such qualities of adaptation as evidenced by these people. There is a great field for serious thought that the assimilation, which will take place anyway, shall take place in the best way.

VIII. Self-Pity

One more thought and I am through. I am much concerned that there appears to be a growing tendency among adults to make young people of to-day sorry for themselves. It is my opinion that this is deplorable. It is a fact that times are difficult and that opportunities for employment are limited, but I would suggest that these people study history. Even if they are sincerely convinced that they, in their generation, have made a mess of things, let them put up to the young people the challenge to go in and do better if they can. The worst thing they can bequeath to the young people is a tendency to be sorry for themselves. I lived amid the depression of the early nineties when the scrub-brush was full of pot gangs and there was no attempt at organized relief. I slept beside straw-stacks and asked for something to eat and, to top it all, travelled part way East with Coxey's army—but I did not feel sorry for myself. If by waving a fairy wand I could trade places with any young man of to-day I would take his youth and let him have my job. I would like to be a young fellow again.

A COMPARISON OF TEMPERATURES IN AIR AND AT VARIOUS DEPTHS IN A LIGHT SANDY SOIL IN SOUTHERN ONTARIO[1]

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The soil concerned in this investigation is classified as Plainfield sand and is typical of a considerable area planted to orchards in Norfolk County. In the area where the records were taken the humus layer is from 2 to 5 inches in depth, succeeded by yellow sand which continues to a depth of approximately 6 feet. At this point grey sand appears and is continuous to depths of from 8 to 11 feet. The organic matter content of the surface soil was less than 2% as determined by analysis. The ground cover consisted of nothing in April and May with from 1 to 4 tons green weight per acre for the remainder of the growing season. The winter cover was the dried residue of the summer crop, which was made up of about one-half oats and one-half various weeds.

Weekly recording thermographs of the two-pen type, with mercury in steel cables were used, with the cables sheathed in lead to prevent damage from climatic or soil conditions. The drum was driven by an eight-day clock which was checked when the charts were changed. The instruments were compared for temperature and lag with a standardized thermometer, over more than the range required, both before and after the period of use, and were found to be accurate to within 1°F. There was no lag in temperature response that would materially influence the accuracy of the results as presented. The instruments were located in an apple orchard, between the tree rows, and enclosed in ventilated shelters similar to those in use by the meteorological service. The nearest trees were 15 feet each way and approximately southwest and northeast from the instrument shelter. Trees on the diagonal, north, east, south and west were 33.5 feet distant.

The bulbs were inserted in the side of a trench, at the required depth, and the trench was filled in and left undisturbed for the two years' test. The unusual uniformity of the soil rendered the filling of the trench a simple operation. The air temperature bulb was held in place just below the floor of the instrument shelter. This seemed to offer the optimum protection

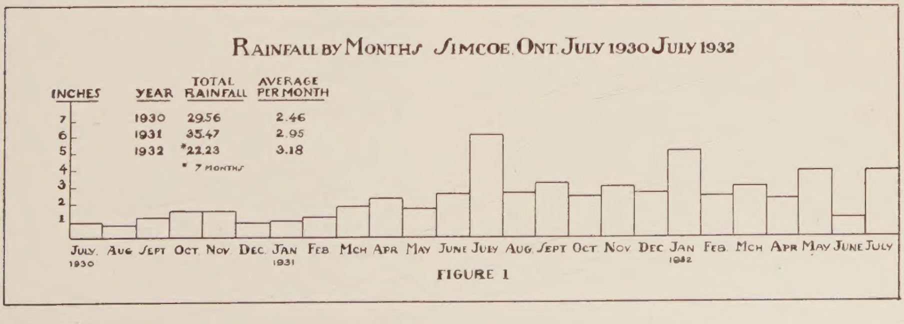
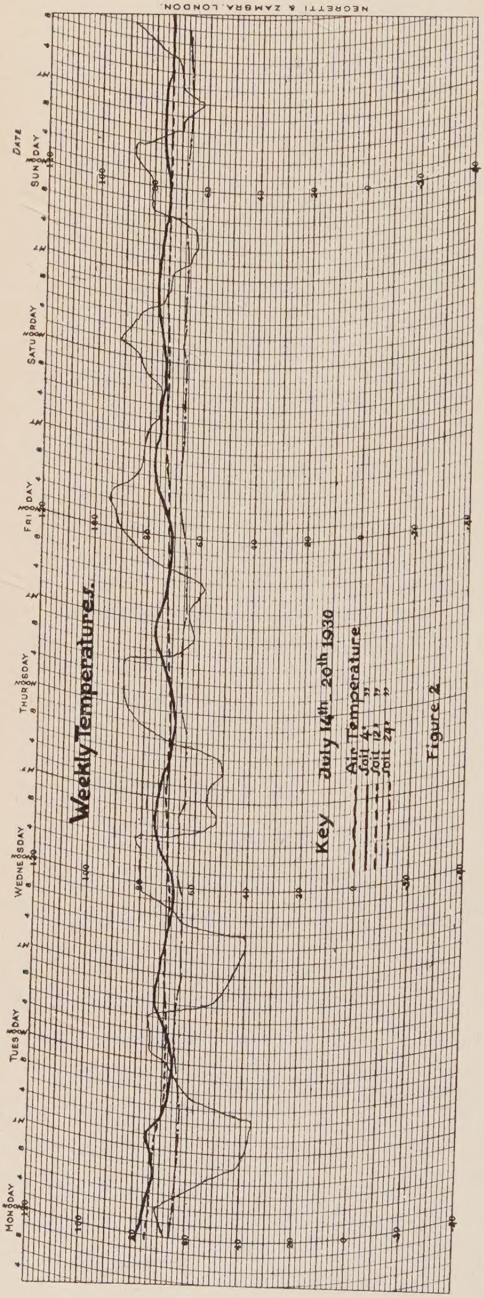
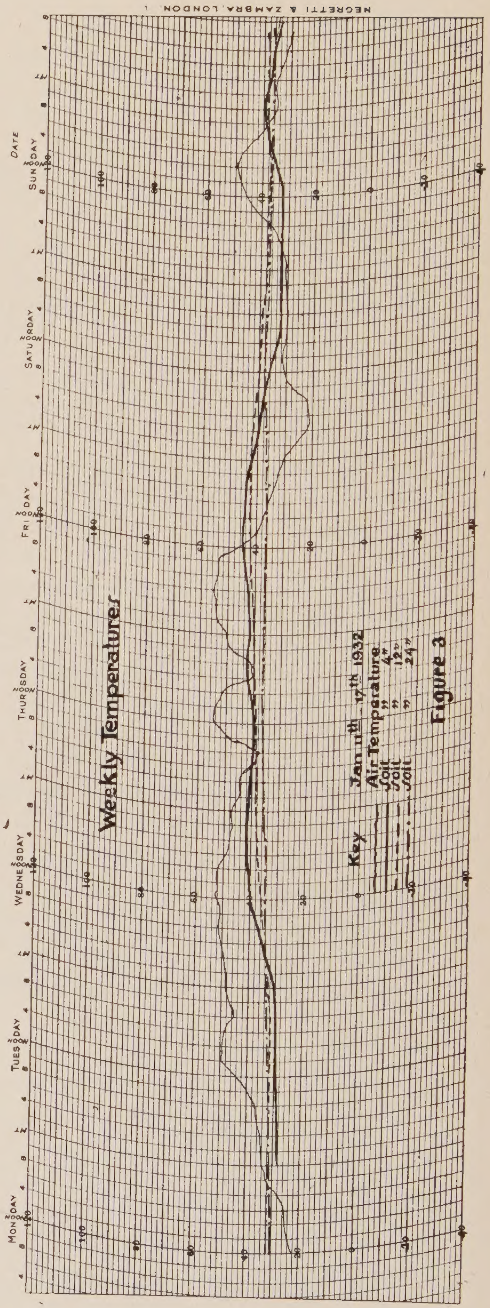


FIGURE 1

[1] Publication authorized by the President.
[2] Assistant Professor of Horticulture, Assistant Professor of Chemistry, and Assistant in Horticulture respectively.


NEGRETTI & ZAMBRA, LONDON.
Weekly Temperatures.
Key
July 14th - 20th 1930
Air Temperature
Soil 4" "
Soil 12" "
Soil 24" "
Figure 2
MONDAY
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
SATURDAY
SUNDAY
DATE


NEGRETTI & ZAMBRA, LONDON.
Weekly Temperatures
Key
Jan 11th - 17th 1932
Air Temperature
Soil " 4"
Soil " 12"
Soil " 24"
Figure 3
MONDAY
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
SATURDAY
SUNDAY
DATE

from the rays of the sun and, at the same time, permit exposure to free air circulation.

The period of temperature study was from July 9, 1930, until July 10, 1932. Temperatures are in Farenheit in all cases and were recorded for air and 4, 12 and 24 inch soil depths.

Precipitation records, obtained through the kindness of Dr. W. E. W. Jackson, Assistant Director of the Meteorological Service, Toronto, Ontario, were taken at a point a few miles distant from the orchard. These are presented in Figure 1. Although the total precipitation for 1930 was normal, the major part occurred during the winter months and, as the chart shows, 1930 was very dry during the growing season. The years 1931 and 1932 were both above normal in total precipitation although they could not be classed as excessively wet. The distribution was reasonably normal thoughout both years.

Temperature Variations

Daily and Weekly. Figure 2 is a weekly chart of the temperatures of the air and three depths of soil covering the period July 14 - 20, 1930; Figure 3 is for the period January 11 - 17, 1932. These are representative of the warmest and coldest periods during the time temperatures were recorded.

The range of temperature variation during the weeks mentioned is:—

July 14 - 20, 1930.	Air	Soil 4″	12″	24″
Daily variation	20-40°	4-12°	1-5°	0-2°
Weekly variation	59°	12°	6°	4°
Weekly maximum and minimum	95-36°	78-66°	75-69°	68-64°
January 11 - 17, 1932.	**Air**	**Soil 4″**	**12″**	**24″**
Daily variation	8-26°	3-10°	2-6°	0-2°
Weekly variation	34°	16°	10°	6°
Weekly maximum and minimum	55-21°	44-28°	42-32°	37-31°

It is evident, both in summer and winter, that the daily or weekly variations in temperature are greatest in air and become less for each increase in soil depth. Winter temperatures show less *weekly* variation in air and slightly greater changes in all depths of soil than do the summer records. The *daily* temperature range is much less for air in winter than in summer and about the same for all soil depths both winter and summer. There is no object in giving a more detailed quantative interpretation to these data as they cover only two short, selected periods.

The time of temperature change in the daily cycle cannot be definitely established for all periods. The time and degree of the change in air temperature are materially influenced by the time, rapidity and degree of the daily variation, so that it is impossible to fix any narrow, definite time at which maximum and minimum occur. Similarly, response of soil temperature to fluctuations in air is not altogether constant in time or amount, depending on the degree of air temperature change and the time over which it occurs. Summer air temperature usually reaches a maximum between 12.00 and 2.00 P.M., occasionally continuing until 4.00 P.M. The minimum was generally around 4.00 A.M., continuing until 6.00 A.M. There was usually a rapid rise in temperature at 6.00 A.M. with a similar drop at 6.00 P.M. but, in both cases, the movement had slackened by 10.00 A.M. and P.M. respectively.

It is impossible to establish any daily maximum or minimum during the winter, the daily rhythm of rise and fall, which occurs in the summer, being absent. During the summer period mentioned, the sun rose at 4.50 A.M. and set at 7.55 P.M. The early incidence of the temperature fall, and the lateness of the rise, was undoubtedly influenced, to a considerable measure, by the shading effect of the trees. It is probable that, otherwise, the rise and fall in air temperature would closely follow sunrise and sunset, and the maximum and minimum would not be as long continued.

Soil temperatures evinced a much more regular rise and fall than did air temperatures. Winter soil temperatures, although changing slowly in direct relation to air temperature, do not show any definite lag therefrom nor any regular variation in time. This is undoubtedly due in some measure to the relatively small daily variation in air during winter but chiefly to the change in direction of winter air temperature largely irrespective of time. That there is a very considerable lag in the response of soil to air temperature changes is clear and, also, that this time lag increases with depth. The summer soil temperatures show a definite time lag from the air. In 4 inches of soil the maximum temperature occurred at 8.00 to 10.00 P.M. and the minimum at 10.00 to 12.00 A.M., a lag of from 6 to 7 hours from air temperatures. At 12 inches depth, the maximum and minimum occur at 12.00 P.M. and A.M. respectively, a lag of 10 hours. The 24 inch soil depth has similarly a lag of approximately twenty-four hours.

Space prevents the presentation of weekly charts for each month, but it would appear that there might be, for time of temperature change, a gradual gradation from these two extremes, during the intervening months, which cover the spring and fall periods.

TABLE 1.—AVERAGE MONTHLY TEMPERATURE

Position	1930						1931					
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Air	73	70	66	51	41	27	24	24	33	45	57	65
4″ Soil	75	72	66	52	42	30	28	29	34	49	59	69
12″ Soil	74	72	68	55	44	34	30	30	36	46	57	67
24″ Soil	67	66	62	49	39	31	27	28	29	40	51	62

Position	1931						1932					
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Air	73	68	64	53	44	33	32	30	25	39	54	66
4″ Soil	77	73	68	54	45	35	—	32	31	44	58	70
12″ Soil	75	72	67	56	47	38	37	34	34	42	57	67
24″ Soil	68	67	63	52	42	35	34	30	30	37	51	61

Monthly and Seasonal Temperatures. Table 1 gives the average monthly temperatures from July 1930 to July 1932 and Figure 4 is a graph of these data. The figures were arrived at by use of the daily maximum and minimum. Data were computed to the nearest degree since fractions thereof would have little significance in the discussion.

The average monthly air temperature is always lower than that in 4 inches of soil. The difference is relatively small but consistent and only in one month, September 1930, does the average air temperature rise to equal the 4 inch soil depth.

In 12 inches of soil, the avearge monthly temperature is higher than the air temperature except in May 1931 when they were equal. At this depth (12″) the temperature is higher from about September to March, inclusive, and lower from April to August than for a similar period at the 4 inch depth. The actual time at which this change-over occurs may vary from year to year, but in general the soil at 4 inches was warmer in the late spring and summer although colder in the fall, winter and early spring than at 12 inch depth.

The trend shown in the 12 inch soil depth is more evident when the data for the soil at a depth of 24 inches are considered. The air temperature was lower than the soil at 24 inches for December and January, but, except for the winter months, air temperatures were always higher. Again, the actual time of the change must vary with the year. The average monthly temperatures at the 24 inch soil depth were lower than in 4 inches of soil, except for the month of December, and they were always lower than the average temperatures for the 12 inch depth.

The average monthly temperature, for all depths of soil and air, fell below 40° in the months of December to March. The soil at 24 inches was on the border line of this temperature in November and April. The average temperature was above 50° for all positions for the months of May to October inclusive.

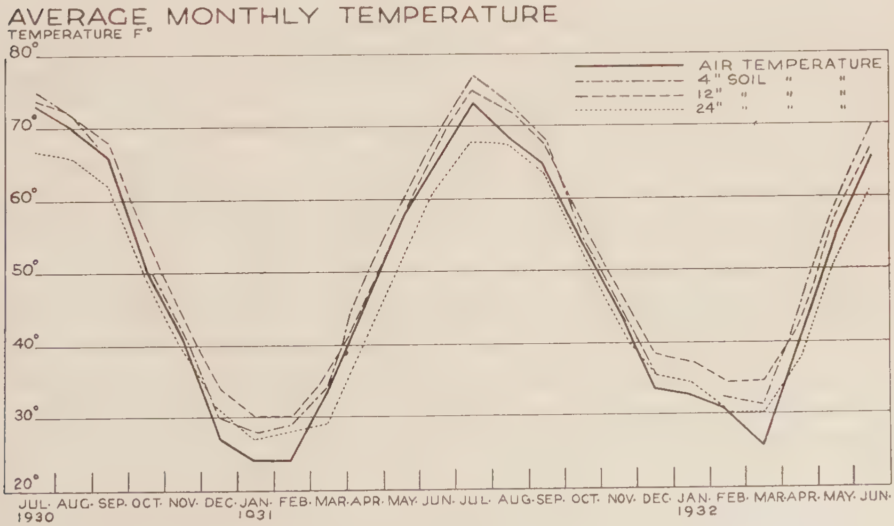


FIGURE 4.

The absolute maximum and minimum temperatures which occurred during the period are of little value as they were often closely approached if not duplicated. The highest temperature recorded was for July 1, 1931, being 105° in air. The maximums were in descending order in all cases: air; soil at 4″; 12″; 24″. The lowest temperatures recorded were in December 1930 and January 1931, being -18°F. in air. The lowest soil temperatures were: 4 inches 20°; 12 inches 25°, and 24 inches 26°. It is evident from the records that no soil approached the air maximum temperature within 10° or came within 20° of the minimum. Usually the latter difference was from 30-35°.

Discussion

Smith (*1*) gives a very complete account of the daily and seasonal air and soil temperatures at Davis, California and (*2*) a comparison of day and night soil and air temperatures. His work covers a period of February to September 1925 and January to June 1927 for air and soil at ½, 3, 6, 12, 24 and 36 inch depths. Climatic differences make it inadvisable to attempt to compare the two sets of data but some of his findings, even though he worked with a loamy soil underlain at 3 feet by fine sand, are of interest, in connection with the present work. One-half and 36 inch depths are not recorded in our data. The narrowing of the range of temperature variation with increasing depth is similar to that reported here as well as the narrower range of variation in winter in comparison to summer. The lag of soil from air temperature was in general quite similar to that reported by Smith, except that there was, in the data submitted, a considerably longer lag at 4″ depth than he reported for 3″. There is no attempt in this work to correlate "atmospheric" with "soil" climatic data.

McCollock and Hayes (*3*) report studies in Kansas of yearly temperature cycles under greater variations in temperature than occur in Ontario. The lessening of temperature variation with depth of soil is evident, although the lag in temperature response was much longer than the Ontario data. There was, in our work, no sudden overturn of temperatures as was found in Kansas in March and the end of October. There, the greatest depth of soil, which showed the highest temperature, quickly changed to the position of lowest temperature, following the rise in temperature of the readings in shallower soil. This was reversed in late October. There is a distinct but gradual change shown for our data, at about the same time and in a similar direction. The divergence of temperature lines, for air and various soil depths, winter and summer, is shown in Figure 4. McCollock and Hayes show a similar but more marked condition. It is probable that the difference in degree of variation in the position of the temperature at various soil depths during the season, as noted between our data and McCollock's, is due to differing climate and, to a lesser extent, changing seasonal conditions. Our data for the two years does not agree perfectly in detail, one year with another.

It would seem from the work of Buoyoucos (*4*, *5*) that there would be a relatively rapid response to heat and cold changes from the air through the sandy soil under discussion. It was pointed out that the ground cover was at all times relatively light, while although the snowfall was 65″ in 1930-31 and 32″ in 1931-32, this did not remain long in this district. There was never a thick blanket of snow on the ground. These considerations explain the drop

in temperature of the 24 inch depth below the 4 and 12 inch depths during the winter. From his findings (*6*) it would seem that there was very little actual freezing of soil at any depth during the winter of 1931-32 and only a moderate amount in the winter of 1930-31.

Acknowledgments

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FURTHER STUDIES OF THE INHERITANCE OF SPORE COLOUR AND PATHOGENICITY IN CROSSES BETWEEN PHYSIOLOGIC FORMS OF *PUCCINIA GRAMINIS TRITICI*[1]

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Introduction

The work reported in the present paper represents a continuation of previously reported investigations (*3*, *4*, *5*) on the inheritance of pathogenicity and urediospore colour in *Puccinia graminis tritici* Erikss. and Henn. The aim of these investigations is to work out as far as possible the inheritance of those characters of physiologic forms that can be made the subject of inheritance studies. As physiologic forms are so similar morphologically as to be practically indistinguishable, the investigation must be confined to characters that are essentially physiological. The most important character which can be studied is the pathogenicity of the physiologic forms as judged by the infection types produced on the differential hosts used in their identification. The only other character which can as yet be conveniently made the basis of inheritance studies is urediospore colour. The normal stem rust urediospore contains two pigments, an orange pigment in the cytoplasm and a more deeply coloured pigment in the spore-wall. The red colour of the spore is the combined effect of these pigments. An opportunity for the study of the inheritance of spore colour was furnished by the appearance of two aberrantly-coloured physiologic forms (*2*), an orange form in which the spore-wall pigment was lacking and two greyish-brown forms in which the cytoplasmic pigment was lacking. Crosses between these strains have formed a basis for a study of the inheritance of both urediospore colour and pathogenicity.

The inheritance studies hitherto reported have been confined mainly to a single cross between form 9*a* (orange)[3] and form 36 (greyish-brown). Obviously generalizations as to the inheritance of pathogenicity in *P. graminis tritici* can not be safely made on the basis of inheritance studies of a single cross. It was, therefore, thought necessary to carry on similar progeny studies on several other crosses to determine the general behaviour of hybrid forms, particularly in the F_2 and F_3 generation. The present paper presents the results of several such progeny studies.

As a number of crosses were investigated, it was impossible on account of the large amount of work involved to study a sufficiently large population of each cross to enable the inheritance of pathogenicity and spore colour to be placed on a factorial basis. A detailed genetic study with this purpose in view should undoubtedly be one of the main objectives of these investigations; but this objective can only be attained by the study of large populations derived from crosses between homozygous parental forms. As crosses between

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[3] Form 9*a* differs from form 9 only by its infection type on the varieties Marquis and Kota which is ($3^{\pm}$) instead of (4).

homozygous forms have been made recently, it may be possible to carry out such a study in the near future.

As the work reported in the present paper is a continuation of that previously reported, it seems advisable to give a brief account of the more important results of the earlier studies. The previous work on the inheritance of pathogenicity may be briefly summarized as follows: 1. It has been established that physiologic forms of *P. graminis tritici* can cross readily with one another. 2. In the majority of the crosses the first generation hybrid forms differ pathogenically from both of the parental forms. In some crosses, however, the hybrid forms are pathogenically identical with one or the other of the parental forms, in which cases the dominance of one parental form over the other is complete. 3. Selfing of the F_1 hybrid forms leads to the production of an F_2 hybrid generation consisting of several physiologic forms among which the two original parental forms commonly occur. 4. Most physiologic forms collected in nature are heterozygous for pathogenicity.

The previous studies on the inheritance of urediospore colour led to the following conclusions: 1. Crosses between orange forms and greyish-brown forms result in an F_1 hybrid form of normal (red) spore colour. 2. A selfing of the normally-coloured F_1 hybrids leads to an F_2 generation composed of strains of four distinct urediospore colours, red, orange, greyish-brown, and white.

Methods

The methods used in the crossing and selfing of physiologic forms have been described previously in detail (*3*, *4*). As the present paper is chiefly concerned with the selfing of F_1 and F_2 hybrid forms, it will be sufficient to outline briefly the methods employed in the selfing studies.

Teliospores of each form selected for selfing were developed on adult plants of susceptible varieties. These plants were infected with a pure culture of the physiologic form to be tested and were kept in a greenhouse maintained at rather low temperatures (55°—65°F.) until telial development was completed. While the rust on these plants was still in the uredial stage each form was again checked to ascertain its purity. When telial formation was completed the teliospores were frozen and subsequently brought to germination by a method previously described by Johnson (*1*).

When the teliospores had begun to germinate, several barberry plants were infected by each form whose progeny was to be studied. After the development of the haploid pustules their nectar was intermixed to ensure an abundant production of aecia. The aecial cups were picked off singly at random, each cup being broken open in a drop of water on a glass slide. The contents of each aecium were used to inoculate a single seedling leaf of the susceptible variety, Little Club. The cultures of mono-aecial origin thus established were identified by their infection types on the differential varieties used for the determination of physiologic forms.

It was not possible to carry out selfing studies on all of the F_1 hybrid forms which had been obtained from the crosses between various physiologic forms. Selfing studies, however, were made on most of the hybrid forms which promised to yield interesting information on the inheritance of pathogenicity or colour, or both. Still less was it possible to make selfing studies

on all of the numerous physiologic forms comprising the F_2 generation of these crosses. Consequently, a few F_2 cultures from each cross were selected for selfing in order that some information might be obtained as to the character of the forms in the F_3 generation.

The Inheritance of Pathogenicity

Crosses between form 9*a* and form 36

Several crosses have been made between form 9*a* (orange) and form 36 (greyish-brown). These forms were thought particularly suitable for crossing studies on account of striking differences in the colour of their urediospores and in their pathogenicity (Table 1). Previous work (*5*) had shown that form 9*a* (orange) was homozygous for both colour and pathogenicity while form 36 (greyish-brown) was homozygous for colour but heterozygous for pathogenicity. Consequently, progeny studies of the different hybrid forms should, in theory, yield similar results for the inheritance of colour but need not be expected to yield identical results for the inheritance of pathogenicity. In this paper the results on the inheritance of colour and of pathogenicity will be discussed separately.

With one exception, the hybrids between these two forms were identified as form 17 or form 17*a*, that is, in the crosses 9*a* × 36[4] the hybrid rust was identified as form 17*a*, while in the reciprocal crosses 36 × 9*a*, the hybrid rust was identified as form 17. The rather slight differences between the hybrids originating from opposite sides of the crosses have been attributed (*5*) to the influence of the cytoplasm of the maternal parent form.

Cross I (a)—9*a* (orange) × 36 (greyish-brown)

The selfing of the F_1 form (17*a*) has been reported in a previous paper (*5*); but, in order to present a complete picture of the progeny studies of this cross, the distribution of physiologic forms in the F_2 generation is again presented in Figure 1.

The inheritance studies of this cross were continued by selfing certain selected F_2 cultures. The distribution of physiologic forms in the F_3 generation is also recorded in Figure 1. An examination of Figure 1 will show that the physiologic forms in the F_3 generation are, with two exceptions, the same ones which were present in the F_2 generation. Of the seven F_2 cultures selected for selfing, one (culture No. 63) is homozygous for pathogenicity while the remaining cultures are, with the possible exception of No. 40, in a heterozygous condition.

Attention might here be called to the differences in breeding behaviour of different cultures of the same physiologic form. The two F_2 cultures of form 1 which were selfed were strikingly different in breeding behaviour as judged by their F_3 progeny. Culture No. 1 produced 16 cultures of form 1 and two cultures of form 36, while culture No. 92 produced two cultures of form 1, two of form 36 and twelve of form 57. Similar discrepancies were found in the breeding behaviour of the three cultures of form 1*a* which were selfed. It is clear, therefore, as has indeed been pointed out in a previous paper (*3*), that different cultures of the same physiologic form may be genotypically different.

[4] In crosses recorded in this manner the pycniospore-containing nectar was transferred from pustules of the last-mentioned to pustules of the first-mentioned form, the aecia from which the hybrid arose being developed in pustules of the first-mentioned form.

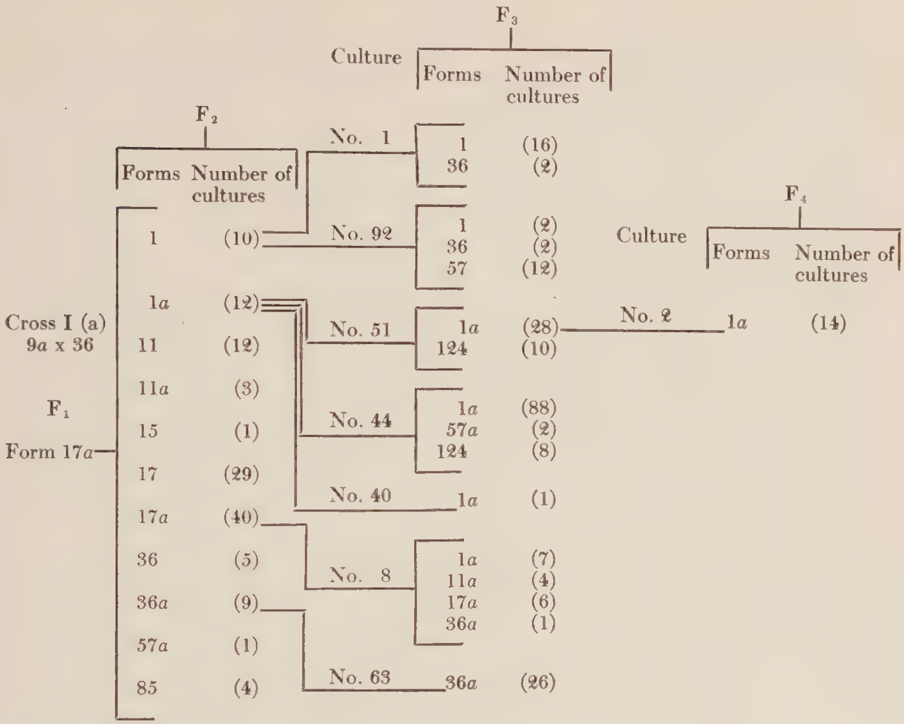

Figure 1. F_2, F_3, and F_4 progeny of cross I(a) — form 9*a* x form 36.

Explanatory Note: The figures in parenthesis represent the number of cultures of each physiologic form identified. The numbers superimposed on the lines connecting the different generations (F_2, F_3 and F_4) are merely the accession numbers assigned to the cultures studied. In all physiologic forms followed by the letter *a* the infection type on the varieties Marquis and Kota is (3) — instead of (4) which is the characteristic infection type of those forms, but these differences were not thought sufficient to warrant the creation of new forms.

The inheritance of pathogenicity in this cross is apparently not very complex. The fact that only eight physiologic forms have appeared in the combined F_2 and F_3 populations would suggest that the inheritance of pathogenicity in this cross is possibly governed by a two-factor difference between the two parental forms.

Only one of the F_3 lines has been selfed (Figure 1). The F_4 progeny of this line indicates that it is homozygous for pathogenicity.

Cross I (b)—9*a* (orange) × 36 (greyish-brown) and reciprocal cross

The F_1 hybrid from the cross 9*a* × 36 was identified as form 17*a* and that from the reciprocal cross 36 × 9*a* was identified as form 17. Both F_1 hybrid forms were selfed. The results of these selfing studies are incorporated in Figure 2.

A comparison of the F_2 progeny of this cross with that of cross I (a) (Figure 1) will show that, in the cross now under discussion, a number of physiologic forms appeared which were not present in the F_2 progeny of cross I (a). The presence of the new forms is due to transgressive segregation which was not evident in the study of the earlier cross. This transgressive segregation is detected by the infection types on the varieties Marquis and

Cross I(b)
$9a$ x 36

F1
Form $17a$

F_2 Forms	Number of cultures
$9a$	(4)
17	(1)
$17a$	(3)
39	(1)

Culture No. 6

F_3 Forms	Number of cultures
9	(2)
$9a$	(9)
$57a$	(2)

Cross I(b)
Reciprocal Cross
36 x $9a$
F_1
Form 17

Forms	Number of cultures
1	(4)
9	(4)
11	(6)
15	(1)
17	(17)
21	(3)
$21a$	(5)
34	(3)
75	(3)
81	(6)
96	(1)
116	(2)

Cross I (c)
36 x $9a$

F_1
Form 17

F_2 Forms	Number of cultures
1	(1)
9	(5)
11	(3)
17	(15)

Figure 2. F_2 and F_3 progeny of cross I(b) — form $9a$ x form 36 and its reciprocal cross, and of cross I(c) — form 36 x form $9a$.

Einkorn. For example, both of the parental forms produce a (3) type of infection on Einkorn, but in the F_2 progeny of the present cross a (1) type of infection is produced on Einkorn by five forms—21, 34, 75, 81 and 116. The difference in the composition of the F_2 progenies of the two crosses is probably attributable to the heterozygosity of one of the parental forms, namely form 36.

Only one of the F_2 cultures from Cross I (b) was selfed. This culture, form $9a$ proved heterozygous for pathogenicity (Figure 2).

Cross I (c)—36 (greyish-brown) × $9a$ (orange)

The F_1 hybrid of this cross was identified as form 17. The small F_2 population which was studied (Figure 2) comprises four physiologic forms all of which had, however, appeared in the F_2 population of cross I (b). Form 17 forms a large proportion of the F_2 progeny as it does in other crosses between form 9 and form 36.

CROSSES BETWEEN FORM 52 AND FORM $9a$

Form 52 differs from form 36 chiefly by the infection type produced on the variety Vernal on which it produces a (4) type of infection while form 36 produces a (1) type. Consequently the elements entering into these crosses are probably not very different from those playing a part in the crosses between forms $9a$ and 36.

Cross III (a)—52 (greyish-brown) × $9a$ (orange)

In this cross form 9 proved dominant over form 52, and the F_1 hybrid was identified as form 9 (red). The form was selfed and a small F_2 population studied. Three forms, 9, 15, and 117 appeared in the F_2 generation. Three of the F_2 cultures were selected for further selfing studies to determine the nature of their F_3 progeny. All three proved heterozygous (Figure 3). The data presented in Figure 3 indicates that inheritance of pathogenicity in this

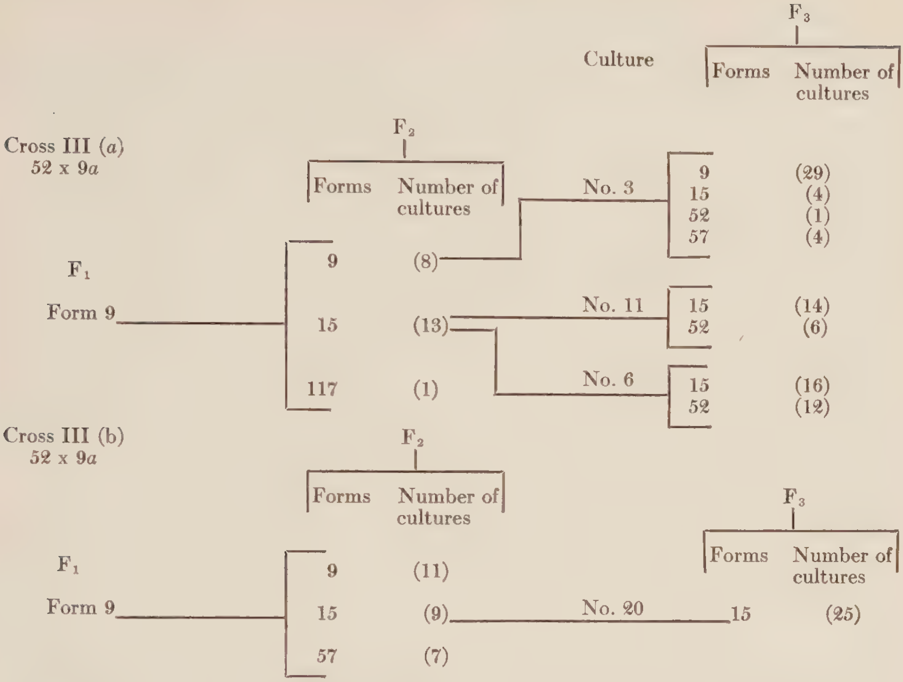

Figure 3. F_2 and F_3 progeny of cross III(a) — form 52 x form 9*a*, and of cross III(b) — form 52 x form 9*a*.

cross is rather simple. Only five physiologic forms appeared in the combined populations of the F_2 and F_3 generations. The fact that the selfing of the two cultures of form 15 produced in each case a population consisting of only two forms suggests that each of these cultures is heterozygous for a single factor.

Cross III (b)—52 (greyish-brown) × 9*a* (orange)

As in cross III (a), the F_1 hybrid was identified as form 9. Selfing of the F_1 hybrid led to an F_2 population consisting of three forms, 9, 15, and 57 (Figure 3). Only one of the F_2 cultures was selfed. This culture, form 15, proved homozygous for pathogenicity as shown by the fact that the twenty-five F_3 cultures studied were all determined as form 15. Two genetically distinct types of form 15 have, therefore, been obtained from the crosses between forms 9*a* and 52, the heterozygous cultures of cross III (a) and the homozygous one of cross III (b).

A CROSS BETWEEN FORM 14 AND FORM 36

Cross IV (b)—36 (greyish-brown) × 14 (red) and reciprocal cross

The F_1 hybrid of the cross 36 × 14 was identified as form 88 and that of the reciprocal cross 14 × 36 as form 14. The difference between the hybrid forms arising from opposite sides of the cross has been attributed (*5*) to the influence of the cytoplasm of the parental forms on the inheritance of pathogenicity. The cytoplasmic influence, in this cross, was detected only by the infection types produced by the hybrid forms on the variety Marquis on which the hybrid form arising from the form-14 side of the cross produced a

Cross IV (b)
36 x 14

F₁	F₂ Forms	F₂ Number of cultures	Culture	F₃ Forms	F₃ Number of cultures
Form 88	78	(2)	No. 13	78	(16)
				120	(3)
				136	(5)
	88	(1)			
	118	(3)			
	119	(3)			
	120	(2)			
	121	(1)			
	122	(1)			

Cross IV (b)
Reciprocal Cross
14 x 36

F₁	F₂ Forms	F₂ Number of cultures	Culture	F₃ Forms	F₃ Number of cultures
Form 14	1*a*	(1)			
	10	(4)			
	14	(7)	No. 16	14	(8)
				17*a*	(1)
				19	(10)
				39	(4)
				53	(2)
				83	(3)
				123	(15)
	15*a*	(1)			
	19	(1)			
	23	(5)			
	53	(4)			
	69	(1)	No. 3	38	(1)
				51	(1)
				69	(37)
	83	(1)			
	115	(1)			
	123	(1)			

Figure 4. F_2 and F_3 progeny of cross IV(b) — form 36 x form 14, and of its reciprocal cross — form 14 x form 36.

(1) type of infection as did the form-14 parent while the hybrid form arising from the form-36 side of the cross produced an (x) type, a result attributed to the influence of the form 36 cytoplasm. Apart from this cytoplasmic influence form 14 was, in this cross, dominant over form 36, as judged by the infection types of the hybrid forms on the other differential varieties.

The hybrid forms arising from the two sides of the cross were selfed chiefly with the object of determining how far this cytoplasmic influence persisted in the progenies. The results of these selfing studies are given in Figure 4. It is clear from an examination of Figure 4 that the same physiologic forms did not occur in the F_2 generations of the two hybrid forms. The difference in the F_2 progeny of the reciprocal hybrids is due largely to the fact that the infection types attributed to cytoplasmic inheritance did persist in the F_2 generation. The majority of the physiologic forms arising from the selfing of form 88 produce an (x) type of infection on Marquis while two forms, 121 and 122, produce a (4) and a (3) + type respectively. The fact that on Marquis the infection types of all the F_2 cultures are not identical is perhaps evidence of segregation of pathogenic factors whose expression is partially inhibited by the cytoplasm. Selfing studies on one of the F_2 cultures, form 78, showed that the (x) type of infection still persists in the F_3 generation. The forms arising from the selfing of the other F_1 hybrid, form 14, show the persistance in the F_2 generation of the (1) type of infection on Marquis, which is characteristic of the form-14 parent. Only two cultures

(one culture of form 1*a* and one culture of form 15*a*) showed a slight deviation from the (1) type of infection. A selfing of two of the F_2 cultures, forms 14 and 69, showed a similar persistence of the (1) type of infection in the F_3 generation on Marquis.

In view of the large number of physiologic forms recovered in the rather small F_2 and F_3 populations studied, it is probable that the inheritance of pathogenicity in this cross is conditioned by several factors. The number of physiologic forms in the progenies from both sides of the cross is increased by the occurrence of transgressive segregation which is detected by the reactions of the variety Vernal. This variety is resistant to both the parental forms but is susceptible to several of the F_2 and F_3 cultures.

TABLE 1.—MEAN INFECTIONS PRODUCED BY PARENT AND HYBRID PHYSIOLOGIC FORMS OF *PUCCINIA GRAMINIS TRITICI* ON TRITICUM DIFFERENTIAL VARIETIES

Physiologic Forms	Reaction of differential varieties*											
	L.C.	Ma.	Krd.	Ko.	Arn.	Mnd.	SpM.	Kub.	Ac.	Enk.	Ver.	Kpl.
1	4	4–	0	3+	1=	1	1=	3+	3++	3	0;	1=
9	4	4–	0	3++	4–	4=	4=	4=	3++	3+	4=	1–
10	4+	2–	3++	2	4	4	4	3++	4–	3+	1=	1=
11	4–	4=	3++	3+	4=	4=	4=	3++	3++	3	1=	1=
14	4+	2–	0;	1++	3++	3++	3++	3++	3++	3	1=	0;
15	4++	4–	4=	3++	4=	4=	4=	3++	3++	3+	4=	1=
17	4	4–	0	3+	4=	4=	4=	3++	3++	3	1=	1=
19	4	2–	0;	3–	4=	4=	4=	3++	3++	3	0;	1=
21	4	4	0	3++	4–	4–	4–	4=	3++	1=	0;	1=
23	4	2	1–	1=	1	1=	1–	3+	3++	3	0;	0;
34	4+	4–	4–	4=	4	4=	4=	4=	3++	1=	0;	1=
36	4	4	4–	3++	1=	1=	0;	X	3++	3	0;	1–
38	4	2=	4–	3–	X+	X±	X+	X+	X++	4–	1=	1+
39	4–	2=	4=	3+	4+	3++	4–	4=	3++	4=	1=	1–
51	4	2–	3=	0;	0;	0;	0;	4	3+	4–	4–	
52	4	4	4–	4	1=	1=	1=	X	4	4–	4+	1–
53	4	2±	0	1	4	4	4	4	4	3±	3±	1
57	4	4–	0	4–	1	1	1	3+	4–	3+	3+	1
69	4	2+	0	0;	1±	1±	1±	3+	3±	3	3+	1
75	4	3+	2+	0;	3+	3+	3+	4–	3+	1	0;	1
78	4	X	0	3=	3–c	3–c	3–c	3+	3+	3+	1	1
81	4	X	0	1+	4	4	4	4	4–	1–	1–	1–
83	4	1+	3–	1–	3+	3+	3+	3+	3+	3+	3+	1
85	4	4–	0	3±	4–	4	4	4	4	3+	X	1
88	4	X	0	1±	4	4	4	4	4	3+	1	1
96	4	X	4	X	4	4	4	4	3+	3+	1	1
115	4	2–	3=	3=	4–	4–	4	4–	4–	3+	3±	1–
116	4	4–	0	3	4	4	4	4	4–	1	4–	1–
117	4	4–	0	0;	4–	4–	4–	4–	4	3+	3+	1–
118	4	X	0	1–	1–	1–	1–	4	4	3+	1–	1–
119	4	X	0	0;	4	4	4	4	4–	3+	3+	1–
120	4	X	0	3=	4	4	4	4	4–	3+	3	1–
121	4	4–	0	0;	1–	1–	1–	4	3+	3	3+	1
122	4–	3+	4–	0;	4	4	4	4	4–	3+	1–	1
123	4	2–	0	3–	3+	4–	4	4	4–	3+	3+	1
124	4	3–c	0	3=c	0;	0;	1=	3+	X	3	X–	1
136†	4	X	0	3=	0;	0;	0;	4–	4	4–	1–	1

Explanation of symbols: O—immunity, 1—high resistance, 2—moderate resistance, 3—moderate susceptibility, 4—complete susceptibility, X—indeterminate (mesothetic) reaction, (;)—hypersensitive flecks. Plus and minus signs indicate a slightly greater and smaller amount of rust than the infection types to which they are suffixed.

* Explanation of abbreviation of varietal names; L.C. = Little Club, Ma. = Marquis, Krd. = Kanred, Ko. = Kota, Arn. = Arnautka, Mnd. = Mindum, SpM. = Speltz Marz, Kub. = Kubanka, Ac. = Acme, Enk. = Einkron, Ver. = Vernal, Kpl. = Khapli.

† The authors are indebted to Dr. E. C. Stakman, and Dr. M. N. Levine for assigning a number to this physiologic form.

The Inheritance of Urediospore Colour

In a previous paper (*5*) an account was given of a number of crosses between physiologic forms of orange and of greyish-brown urediospore colour. The F_1 hybrids of these crosses possessed, in most cases, urediospores of normal (red) colour. Some exceptions, however, occurred in which the hybrid spores were orange in colour. By a selfing study of one of the red hybrid forms it was shown that F_2 cultures of four distinct spore colours were produced, namely: red, greyish-brown, orange, and white.

Selfing studies have now been carried out on several F_1 hybrids as well as on some of the F_2 cultures with the purpose of throwing further light on the inheritance of urediospore colour. The observations on the inheritance of spore colour have been carried out, for the most part, simultaneously with the pathogenicity studies already reported in the present paper. The F_2 and F_3 populations studied have in all cases been too small to permit the inheritance of spore colour to be placed on a statistically proved basis Nevertheless, enough information has been obtained to indicate in a general way the manner of colour inheritance.

CROSSES BETWEEN PHYSIOLOGIC FORMS OF NORMAL (RED) UREDIOSPORE COLOUR

Several crosses have been made between physiologic forms of red uredial colour. Crosses between form 9 and forms 15 and 53 produced F_1 hybrids of red uredial colour. A cross between form 17 and form 49, which has been previously reported, proved an exception through the appearance of a greyish-brown hybrid form in its F_1 progeny.

Selfing studies on the red F_1 hybrids of the above-mentioned crosses showed that with one exception they were homozygous for red urediospore colour. The exception was the F_1 hybrid of the cross between form 9 and form 15 in whose F_2 progeny both red and greyish-brown physiologic forms appeared. This result has previously (*5*) been attributed to the heterozygous condition of the form-15 parent. Although the majority of physiologic forms occurring in nature are undoubtedly homozygous for colour, it has been shown (4) that certain naturally-occurring forms are heterozygous for the factor determining greyish-brown urediospore colour. Of the naturally-occurring physiologic forms which thus far have been selfed none has given rise to orange uredia in its progeny.

CROSSES BETWEEN ORANGE AND GREYISH-BROWN PHYSIOLOGIC FORMS

All the crosses between orange and greyish-brown physiologic forms have produced F_1 hybrids of red urediospore colour. In some of the crosses, however, orange as well as red F_1 urediospores were formed. Selfing studies have been made on the F_1 hybrid forms of both these colour types with results which are presented in Table 2.

With the exception of cross I (a) which has been previously reported (*5*), the F_2 populations studied were so small that there is no assurance that the data for the distribution of colour are truly representative of colour inheritance. Of the five red F_1 hybrid cultures which were selfed (Table 2) two produced F_2 progeny consisting of red, greyish-brown, orange, and white cultures; one produced red, greyish-brown, and orange but no white cultures;

one produced red and greyish-brown cultures only; and one produced an all-red progeny.

The F_1 culture described as Mars Yellow (a colour almost intermediate between red and orange) produced an F_2 progeny divisible into four colour groups; Mars Yellow, Sayal Brown, orange, and white. The two first-mentioned groups were lighter in colour than the corresponding red and greyish-brown groups of the other hybrid forms. These colour differences appear to be due to a lighter pigmentation of the spore wall which is evidently an inherited characteristic.

TABLE 2.—DISTRIBUTION OF COLOUR IN F_2 GENERATION

Urediospore colour of parent forms	Urediospore colour of F_1 culture	Urediospore colour in F_2			
		Red	Greyish-brown	Orange	White
Cross I (a), 9*a* orange x 36 greyish-brown	Red	59	22	47	7
" I (b), 36 greyish-brown x 9*a* orange	Red	48	3	4	–
" I (b), 9*a* orange x 36 greyish-brown	Red	7	2	–	–
Cross I (c), 36 greyish-brown x 9*a* orange	Mars Yellow	3*	2†	13	6
Cross III (a), 9*a* orange x 52 greyish-brown	Red	11	–	–	–
" III (a), 52 greyish-brown x 9*a* orange	Red	5	2	11	4
" III (b), 52 greyish-brown x 9*a* orange	Orange	–	–	20	7
Cross IV (b), 36 greyish-brown x 14 red	Red	9	4	–	–
" IV (b), 14 red x 36 greyish-brown	Red	19	8	–	–

* The three cultures in the red group had a pronounced yellowish tint and were classified as "Mars Yellow" according to Ridgway's Colour Standards.

† The two cultures in the greyish-brown group were decidedly paler than other greyish-brown cultures and were classified as "Sayal Brown" according to Ridgway's Colour Standards.

The selfing of the orange F_1 culture of cross III (b) produced 20 orange and 7 white F_2 cultures. This result, therefore, shows heterozygosity for orange colour and indicates that one of the parental forms (52 greyish-brown) was heterozygous for the factor governing the pigmentation of the spore wall.

In order to determine the distribution of colour in the F_3 generation, a few F_2 cultures of each colour group were selected for selfing. The data obtained from these selfing studies have been incorporated in Table 3. The two red F_2 cultures of cross I (a) proved heterozygous, as is shown by the appearance of red and orange cultures in the F_3 populations. The red F_2 culture of cross I (b) is apparently homozygous for red spore colour. The F_2 culture of cross I (a) described as antique brown (somewhat intermediate between red and orange) was almost identical in its breeding behaviour with the before-mentioned Mars Yellow F_1 culture of cross I (c). Two cultures of typical red colour, however, appeared in the F_3 progeny along with four cultures of the characteristic antique brown colour. At present no satisfactory explanation can be given for the appearance of red cultures in the F_3 progeny.

Of the three orange F_2 cultures which were selfed, two were found homozygous for colour while one was heterozygous. The heterozygous culture, cross III (a), produced an F_3 progeny of 21 orange and 7 white cultures.

TABLE 3.—DISTRIBUTION OF COLOUR IN F_3 GENERATION

Urediospore colour of parent forms	F_2 culture number	Urediospore colour of F_2 culture	Urediospore colour in F_3			
			Red	Greyish-brown	Orange	White
Cross I(a), 9*a* orange x 36 greyish-brown	1	Red	17	–	1	–
	51	Red	34	–	4	–
	92	Antique brown	6*	5†	4	1
	44	Orange	–	–	98	–
	8	Orange	–	–	18	–
	63	Greyish-brown	–	26	–	–
Cross I(b), 9*a* orange x 36 greyish-brown	6	Red	13	–	–	–
Cross III(a), 52 greyish-brown x 9*a* orange	6	Orange	–	–	21	7
	11	Greyish-brown	–	12	–	8
	3	White	–	–	–	38
Cross III(b), 52 greyish-brown x 9*a* orange	20	White	–	–	–	25
Cross IV(b), 36 greyish-brown x 14 red	24	Red	22	2	–	–
Cross IV(b), red x 36 greyish-brown	16	Red	25	18	–	–
Cross IV(b), red x 36 greyish-brown	3	Red	39	–	–	–

* Four of the cultures in the red group were classified as "antique brown" according to Ridgway's Colour Standards.

† The cultures in the greyish-brown group were classified as "Sayal Brown" according to Ridgway's Colour Standards.

Of the two greyish-brown cultures which were selfed one was homozygous for greyish-brown colour, the other was heterozygous and produced an F_3 progeny of 12 greyish-brown and 8 white cultures.

The two white F_2 cultures were homozygous for white spore colour.

CROSSES BETWEEN RED AND GREYISH-BROWN PHYSIOLOGIC FORMS

Table 2 contains the colour distribution resulting from the selfing of the red F_1 hybrid forms of cross IV (b) between form 14 (red) and form 36 (greyish-brown). Two colour groups only, red and greyish-brown, appeared in the F_2 generation. As both parental forms were known to be homozygous for colour these two colour groups were expected to appear in the proportion of three red to one greyish-brown. The fact that the observed data do not fit this ratio exactly is perhaps due to the smallness of the F_2 populations.

This study was extended to the F_3 generation by a selfing of three of the red F_2 cultures. As shown by the data in Table 3 two of the cultures were heterozygous for colour while one was homozygous for red spore colour.

CROSSES BETWEEN A RED AND A WHITE PHYSIOLOGIC FORM

Two crosses have been made between form 95 of red and form 1*a* of white urediospore colour. In both crosses pycniospore-containing nectar of form 95 was transferred to haploid pustules of form 1*a* (white). In the first cross aecia developed in one of the pustules to which nectar was transferred. The F_1 uredial cultures resulting from the inoculation of wheat seedlings with the aecia were identified as form 95*a* (red). In the second cross aecia likewise developed in one of the nectar-receiving pustules of form 1*a* (white) and these aecia gave rise to red uredial cultures which were ident-

ified as form 21*a*. As the aecia were in both instances formed in pustules of orm 1*a* (white) there can be no doubt as to the authenticity of the crosses. These crossing experiments may, therefore, be regarded as an experimental confirmation of the dominance of red spore colour over white.

Discussion

It is apparent from the results presented in the present paper that the inheritance of pathogenicity is not by any means a simple phenomenon, and, as yet, there is but little evidence to indicate its exact nature. The inconclusiveness of the results is due partly to the fact that homozygous forms were not available as parental material when the earlier crosses were made and partly to the smallness of most of the F_2 and F_3 populations which have been studied. Certain results which have been obtained point, however, to a Mendelien manner of inheritance. Thus, in some crosses one physiologic form shows dominance over another. Furthermore, when hybrid forms are selfed, the parental forms are not uncommonly recovered in the F_2 progeny along with other forms which show some of the pathogenic qualities of the parent forms. Hence there is evidently a segregation and subsequent recombination of factors determining pathogenicity. Segregation undoubtedly occurs during one or the other of the two divisions of the teliospore nucleus, and recombination takes place in the aecial primordia in the leaf tissues of the barberry.

In some of the crosses (e.g., crosses I (a) and III (b)) it has been shown that some of the F_2 cultures are homozygous for pathogenicity although the majority are heterozygous, as would be expected if Mendelian laws of inheritance were operative. There is also some evidence that a continued selfing of the progeny of a cross tends towards homozygosity in the forms of later generations. Thus the selfing of F_2 cultures generally results in fewer physiologic forms than the selfing of F_1 hybrid forms.

Inheritance of pathogenicity is not, however, wholly determined by Mendelian factors as has been pointed out in previous papers (*3*, *5*) in which certain pathogenic characteristics noticeable in the F_1 cultures of some crosses were attributed to the influence of the cytoplasm of one or the other of the parental forms. In these crosses, which were made reciprocally, the F_1 hybrid forms arising from opposite sides of each cross were not identical in pathogenicity as they should have been if Mendelian factors alone governed the inheritance of pathogenicity. The fact that the differences observed in the reciprocally produced F_1 hybrid forms did persist unchanged in their F_2 and F_3 progeny confirms the original assumption of an extra-nuclear cause. (See text discussion of cross IV (b)).

The results on the inheritance of urediospore colour are somewhat more definite than those on the inheritance of pathogenicity. Urediospore colour is apparently inherited independently of pathogenicity and not in any way linked with it as was tentatively suggested in an earlier paper (*5*). Normally-coloured urediospores of stem rust possess two pigments, an orange pigment in the cytoplasm and a brownish pigment in the spore-wall. The combined effect of the two pigments is the normal, red colour of stem rust spores. In most strains of stem rust no segregation of colour factors takes place, and urediospore colour is inherited as a unit. The occasional appearance of orange and greyish-brown colour variants has, however, furnished an opportunity

of throwing some light on the genetics of colour in stem rust. The following facts have been established through crossing studies with orange and greyish-brown strains. 1. Crosses between orange and greyish-brown strains produce F_1 hybrids of normal (red) colour. 2. Selfing of the red F_1 hybrids results in an F_2 generation composed of red, orange, greyish-brown, and white strains; the red strains are the most numerous, the white strains the least. Selfing studies with the red F_2 cultures indicate that they fall into several genetically distinct types. Some are homozygous for red colour; others break up into red, orange, greyish-brown, and white cultures; and still others break up into red and orange cultures. Greyish-brown cultures are either homozygous or heterozygous, the latter breaking up into greyish-brown and white cultures on selfing. Similarly, orange cultures are either homozygous or heterozygous, if the latter they break up into orange and white cultures. The white cultures are all homozygous for white spore colour.

The results of the selfing studies thus far carried out would indicate, therefore, that the inheritance of urediospore colour in crosses between orange and greyish-brown strains may be explained by assuming the presence of two pairs of Mendelian factors, of which one governs the pigmentation of the spore wall, the other the pigmentation of the cytoplasm. If G represents the factor determining the greyish-brown colour of the spore wall and Y the factor determining the yellow or orange colour of the cytoplasm, the constitution of the greyish-brown parental strain would be GGyy and that of the orange parental strain ggYY. The heterozygous red F_1 hybrid form would then possess the constitution GgYy. Selfing of the F_1 hybrid form would then result in F_2 progeny of the following genotypic constitution and breeding behaviour.

Urediospore colour in F_2	F_2 genotype	F_3 progeny
Red	GGYY	Red
Red	GgYY	Red and orange
Red	GGYy	Red and greyish-brown
Red	GgYy	Red, greyish-brown, orange, and white
Greyish-brown	GGyy	Greyish-brown
Greyish-brown	Ggyy	Greyish-brown and white
Orange	ggYY	Orange
Orange	ggYy	Orange and white
White	ggyy	White

It should be pointed out that the scheme of colour inheritance advanced above must be regarded as more or less provisional as it has not been experimentally confirmed in all its details. In a number of selfing experiments the ratios between the different colour groups have failed to approximate Mendelian ratios. However, the lack of agreement with Mendelian ratios may perhaps, in these instances, be ascribed to the smallness of the populations studied.

Summary

1. Selfing studies have been made on a number of F_1 hybrid forms and F_2 cultures of crosses between physiologic forms of *Puccinia graminis tritici*.

2. In the selfing of an F_1 hybrid form segregation and subsequent recombination of the factors governing pathogenicity lead to the production of an F_2 population comprising several different physiologic forms among

which the original parental forms are frequently found. The number of physiologic forms present in the F_2 generation is definitely greater in some crosses than in others, indicating that the same number of factors is not involved in all crosses.

3. Selfing studies on F_2 cultures of several crosses have shown that some of the F_2 cultures are homozygous but the majority are heterozygous for pathogenicity. The progeny of a heterozygous F_2 culture generally contains fewer physiologic forms than that of an F_1 hybrid form.

4. In a previous paper certain pathogenic differences noted in F_1 hybrid forms originating from opposite sides of reciprocal crosses were attributed to the influence of the cytoplasm. These pathogenic differences have persisted in all the individuals of the F_2 and F_3 generations and do not, therefore, appear to be subject to segregation and recombination as are other pathogenic characters in the same crosses. These results appear to support the original assumption concerning the influence of the cytoplasm.

5. Although the inheritance of urediospore colour has not been worked out in all its details, there is every indication that it is Mendelian in character. The factors for orange and greyish-brown pigmentation are, in a sense, complementary factors, and the inheritance appears to be analagous to the well known Rose and Pea comb type of inheritance in fowls. Red spore colour appears to be due to the presence of two dominant factors for orange and greyish-brown. White spore colour may be explained by the presence of their recessive allelomorphs.

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THE BALSAM WOOLY APHID, *ADELGES PICEAE* (RATZ.) IN CANADA

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INTRODUCTION

When the study of this insect in the Maritime Provinces was first commenced in 1931 it was largely devoted to an explanation of the so-called "gout disease" of balsam fir (*Abies balsamea* (L) Miller), the cause of which was then unknown. Owing to the fact that this condition had attracted the attention of several investigators (*8*, *7*, *3*) and was causing concern to pulp companies, one of which had employed a pathologist to study it, a brief account of the insect and how it brought about the "gout" was published in 1931 (*2*). Work on this problem has continued since then, and as a number of enquiries have been received from Canada and the United States it is thought advisable to record some further results at this time. As certain phases of the study need several years to complete, a full technical account will be prepared later.

THE NAME

Previously, this species has been placed in the genus *Dreyfusia* Borner. Annand, however, has put forward good reasons for the reduction of the genera of the Adelginae to *Adelges* and *Pineus* (*1*). This arrangement is followed and the scientific name becomes *Adelges piceae* (Ratz.). The common names in use are: balsam woolly aphid, balsam bark louse, balsam chermes and (in Europe) silver fir chermes. The first is considered preferable.

HISTORY IN EUROPE

The species has been studied in Germany, France, Denmark, England, Switzerland and Russia, but the literature will not be fully reviewed here. The most complete study is that of Marchal (*10*), who in 1913 reviewed the previous work and described careful experiments elucidating the life history. There is a good deal of confusion in the literature owing to the fact that there are two very similar forms which were not separated until 1904 and were both considered to be *Chermes piceae* as described by Ratzeburg in 1843. Several workers since then have brought evidence that there are two closely related species, separable biologically and morphologically. These species, *Adelges piceae* (Ratz.) and *A. nusslini* (Borner), are now generally accepted, but some writers consider that they may be simply biological races (*5*, *4*).

A disease of fir, chiefly exotic species, consisting of swellings of the buds and twigs, was described in Europe at different times but the cause was unknown until 1903 (*11*). In that year, Cholodowsky gave the name *Chermes piceae* var. *Bouvieri* to what he considered to be a variety of *piceae* which he found to be the cause of this condition. It has been shown that *piceae* will bring about these swellings whenever it attacks certain species of *Abies* and the name is obsolete.

[1] Entomologist-in-charge.

Reports of European writers differ somewhat as to the amount of damage done by *A. piceae*. Some consider that it does not kill trees, others note that it sometimes kills occasional trees by attacking the stem. It seems to be generally agreed, however, that the serious damage to fir from chermes attack is caused by *A. nusslini*, which is found mostly on the twigs, and which is frequently referred to as doing widespread damage, particularly to young plantations.

There is again, however, some difference of opinion as to whether the dying of fir (mostly *A. pectinata*) is the result primarily of attack by the insect, or results from other causes such as poor soil conditions, the insect being secondary. Schubert (*13*) quotes Professor Bernhard as saying that fir in Saxonia is "not a dying tree, but is already extinct". He says that similar, though not quite as serious, conditions obtain in many other provinces and puts forward evidence that poor soil conditions, associated with acidity, are the real cause of this. Chrystal (*5*, *6*), while not questioning the insect's responsibility, notes that in Denmark the injury is greatest on poor soils.

Conditions apparently vary at different points on the continent as well as with local differences of site, age, etc. This may explain, for instance, why Schneider-Orelli (*12*), working in Switzerland, recommends growing fir in shade, and Chrystal and Boas (*6*, *4*) from observations in the British Isles and Denmark recommend thinning to let in the light. Also, there are differences of opinion as to the behaviour of the two species. Most writers speak of *nusslini* and *piceae* being found in close association on the same trees while Schneider-Orelli (*12*) states emphatically that while they occurred in the same stands they were never found together on the same trees, although a careful study was made over a period of two and one-half years.

There are frequent references to *A. piceae* as the "stem form" and *A. nusslini* as the "twig form" ,and it has been considered by some authors that *piceae* tends to be confined to the stem while *nusslini* is confined to the twigs. Others have shown, however, that both species may occur on the twigs and on the stem of quite large trees. Although there does seem to be a preference for these respective points of attack it is not sufficiently strong to be used even as an aid in separating the two species.

History in North America

Kotinsky (*9*) reported finding *piceae* killing trees in New Hampshire in 1916. The determination was apparently carefully made. He states, also, that he examined material collected by Hopkins at Brunswick, Me., in 1908 and determined it as the same species. At the same time he secured egg masses and adults from twigs collected by Felt on imported specimens of *A. nordmanniana* in 1910. These he considered to be *nusslini* but the determination was provisional as he apparently did not examine the neosistens and seems to have based his determination on the fact that the insects were on the young growth.

Annand (*1*) records taking *piceae* from several species of *Abies* in California and *nusslini* in association with it on *pectinata* and *nobilis*.

References to the occurrence of *piceae* in New Haven, Conn., seem to be due to an error in the abstract of Kotinsky's paper in the Review of Applied Entomology where New Hampshire was mistaken for New Haven. Dr.

R. B. Friend, of the Connecticut Experiment Station, states that it has not yet been observed in that state.

During the past two years, Dr. H. B. Peirson, State Entomologist, has reported a number of infestations in Maine and in 1933 Dr. H. I. Baldwin, of the New Hampshire Forestry Department, reported attacks in New Hampshire and Vermont. Other reports have come from New York but their authenticity is uncertain, Material sent to this laboratory from Maine by Dr. Peirson and from New Hampshire by Dr. H. J. MacAloney proved to be *A. piceae.*

In Canada, Swaine (*14*) reported the presence of *piceae* in Nova Scotia in 1929. Since that time the writer has found that it is present throughout the whole of that province and the extreme southern part of New Brunswick. The approximate northern boundary of the infested area is a line drawn from Shediac to Fredericton, along the St. John river to Rosborough and down to the border at Vanceboro. Along the coast and for some 20 or more miles inshore the infestation is practically continuous. As the observer approaches the above line it consists of small isolated centres of concentrated attack. North of the line the insect has not yet been found. Infested material has been received from Prince Edward Island.

It is of considerable interest that this infested area roughly coincides with that of the beech bark scale (*Cryptococcus fagi* Bsp.), another European species of similar size and habits, which is likewise parthenogenetic and wingless, and dependent on the same means of dispersal.

A. piceae has been in Nova Scotia for over twenty years. Analysis of trees in Shelburne and Digby counties has shown evidence of attack as far back as 1910. The infestation in eastern Nova Scotia and in New Brunswick is more recent.

While Annand reports and figures *A. nusslini* from California, none of the reports of its presence in the East seem to have been based on examination of the integument. All the material so far examined in the Maritimes has proved to be *piceae,* both in its biology and morphology.

Life History

As in Europe, the life history is confined to *Abies*, there being no generation migrating to spruce. Although a winged form appears in small numbers it does not settle on our native spruces, or on *Picea excelsa*. *P. orientalis* has not yet been tried. These are more probably *exules alatae* than *sexuparae* although the author has as yet been unsuccessful in getting them to oviposit on either fir or spruce.

Hiemosistentes.—Near Fredericton, N.B., only the first stage larvae (*neosistens*) survive the winter although adult *aestivosistentes* and eggs remain alive and capable of oviposition and hatching for some time after the first low temperatures, surviving even 3° F.

These larvae commence to feed during April, about the time that the first signs of swelling appear in the buds of the balsam fir. Moulting begins around the end of the month, although some individuals are much later and may not start to develop until others have commenced to lay eggs. This is dependent on the temperature at the bark, but also on inherent factors. There are three moults.

Oviposition commences around the middle of May and the eggs start to hatch about the end of the month. Fifty or more eggs may be laid before hatching begins. The adult continues to lay new eggs while the earlier eggs hatch. The total number laid varies greatly. While some may lay close to 200 the average is probably not over 100.

Progredientes and Alatae.—The first few eggs of some of the *hiemosistentes* produce larvae of the *progrediens* type which settle mostly on the under sides of the needles and feed through a stoma. Some settle on the axis of the new shoot. They are slightly smaller and do not become highly sclerotized like the sistens type, remaining brownish-red instead of turning black. Their stylets are shorter and no wax pores are visible. They commence to develop immediately into two forms.

One form, found only on the needles, has little or no wax secretion and after the second moult becomes distinctly elongate. The fourth stage is a "nymph" and the fifth a winged adult. Although attempts have been made during three seasons to get these winged forms to settle on native and European spruces or on other firs, they have failed to do so and no eggs have been laid by them.

The other form, found on the new shoots and needles and sometimes on older growth, also has five stages but remains wingless and produces eventually a considerable covering of wax threads. Less than 10 eggs are laid and these produce typical sistentes, some of which are *aestivosistentes.*

These *alatae* and *progredientes* are quite scarce but can be found fairly easily in the forest. Many trees lack them entirely. The tendency to produce them seems to be hereditary but may be discouraged or inhibited on the older parts of the stem, where only the apterous form may survive and is rarely seen. The only European writer who seems to have found these forms of *piceae* is Marchal (*10*), who collected five or six specimens in the field and reared a number experimentally. Some of his winged forms laid eggs on fir and were evidently *exules alatae.*

I have found one typical *progrediens* larva overwintering on the stem of a large tree. This is difficult to explain. When brought inside it developed to the second stage with long wool threads and was evidently of the apterous type.

Aestivosistentes.—The great majority of the eggs laid by the overwintering forms produce the *sistens* type of larva which settles on the bark and in a few days becomes black with a fringe of wax plates around the margin and down the mid-dorsal line. These *neosistentes* may be found at any time of the year on any part of the tree from the base of the stem to the end of the new shoots. Only in a few cases have they been found on the needles, and these failed to develop.

These larvae go through a varying period of dormancy of 2 to 6 weeks, or more, after which feeding commences and in about 10 days the adult stage is reached. They are the *aestivosistentes.* They are not as prolific as the previous generation, producing, as a rule, less than 50 eggs and at a slower rate. Most of them live until the cold weather in the fall and many continue to oviposit until permanent freezing temperatures occur. Their eggs produce larvae which hibernate—the *hiemosistentes.*

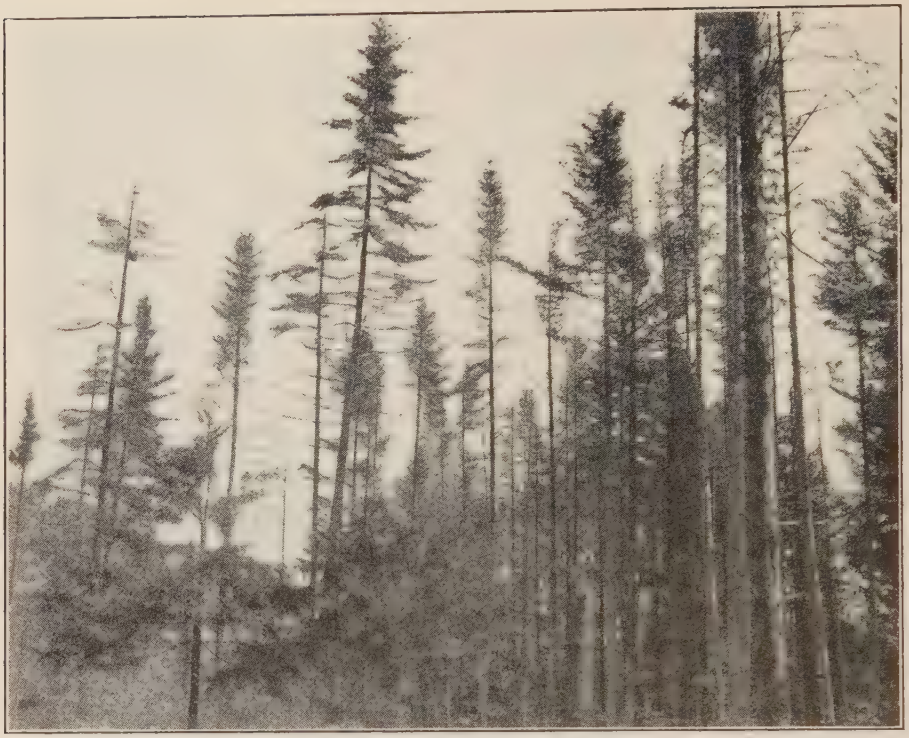

Figure 1. Stand killed by *Adelges piceae* (Ratz.). A number of dead trees cut out on left

Figure 2. Stages in development of "gout", or injury by attack on twigs. Tree on right shows first year, tree in centre third year of attack. Note shortening and depression of shoots.

The reproduction of this species is thus seen to be practically confined to two fairly clear-cut generations of *sistentes*. These are recognized at their peaks by the appearance of a noticeable quantity of fresh "wool" on the trees in May and August, when the greatest numbers of adults appear. Later, the wool is to a large extent washed away by rain. There is a period in early July when the population consists almost entirely of larvae, as also during the winter.

Marchal reports two generations of *aestivosistentes* as the rule in France. Two may occur in the Maritimes, but if so, only rarely.

The Effect on the Tree

The *sistentes* have stylets of an average length of about 1.5 mms., sometimes being as long as 2 mms. These are thrust intercellularly into the cortical parenchyma, eventually to their full extent. Apparently a stimulating substance is injected from the salivary glands shortly after the larva settles, as hyperplasia often results even if the larva is killed before it starts to feed.

When feeding commences, the stylets are retracted and protracted in a probing movement so as to reach a considerable number of the cells. The pathway of the stylets is marked by a heavily staining stylet sheath. Cells within or adjacent to this point of feeding undergo some unusual changes. They become enlarged, the walls are usually thickened and often ridged. The nucleus also becomes much enlarged and granular. If the feeding is severe these cells eventually form a pocket of dead material impregnated more or less with resin-like substances. Around this, in the case of *A. balsamea*, a secondary periderm is laid down, generally in the following year, if the attack is not too heavy to prevent it. Layers of purplish cork-like cells are laid down on the inside of the cambium and parenchyma on the outside. Thus, small purple pellets are found inside the cortex which can be lifted out intact from the surrounding parenchyma, abscission taking place outside the cork.

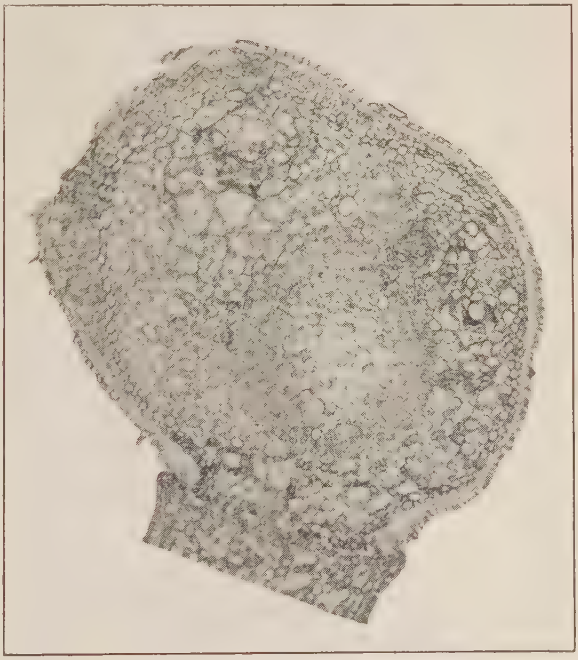

Figure 3. Crossection of one-year old shoot of *Abies balsamea* in winter showing effect of attack since previous spring. Note enlarged cells at older point of feeding. Swelling has ruptured epidermis.

In the case of *A. balsamea, grandis, nobilis,* and *concolor*, an increase in the growth of normal cortical parenchyma cells also takes place around these areas of feeding and this results in the swellings of the shoots and twigs which are known in Nova Scotia as "gout". It also causes a "pimply" appearance on many stems as a result of the preference of the insect for the lenticels or leaf scars. Sometimes the bark of the stem is noticeably thickened and of an unusual spongy texture as a result of heavy attack causing an increased amount of parenchyma and intercellular spaces.

There is at the same time, at least in the case of *Abies balsamea*, a stimulation of the cambium and an increased production of xylem in the neighbourhood of the feeding. The wood is dark, hard and brittle, and consists of cells with heavily thickened walls, similar to those of the "rotholz" produced on the under side of leaning stems. This effect is more or less local and contributes to the swollen appearance.

These swellings appear most often at the buds and nodes which are favourite places of attachment. The amount of swelling depends on the species and the individual tree and the degree of attack. Sudden heavy attack causes little swelling, while one or two larvae may cause a good deal.

Frequently, the buds of attacked shoots fail to develop and the twigs continue to grow in diameter but not in length. Often they gradually die back and after a number of years trees are killed in this way. When the attack is on the trunk, death may result in two or three years. Some trees, however, may carry a light infestation for many years without serious injury while others may support a moderate attack for a long time but in the process become stunted and distorted, generally with a flat top, very rapid taper and a great deal of hard, brittle wood in the outer rings.

In none of the author's experiments has swellings appeared on *A pectinata* although the enlarged cells occur and the tree is gradually killed back. Chrystal (5) has studied the effect of *nusslini* on the shoots and found similar enlarged cells. It is of considerable interest that he obtained swellings with *nusslini* on *A. grandis* but not on *A. pectinata* or *A. nordmanniana*. Previously, only *piceae* had been found to cause swollen twigs and Chrystal suggests that this may be evidence that *piceae* and *nusslini* are biological races. Evidently the species of tree is at least as important as the "species" of insect. In the author's experiments, however, *piceae* has caused swellings on *A. nordmanniana*.

Chrystal found that the abnormal cortical tissue partially replaced the xylem in the new shoots, and explained the injury by *nusslini* as a result of interference with the water supply in this way. The author finds that the same thing happens with *piceae* on *A. balsamea* but it is not the main cause of injury.

A detailed discussion of the effects of the insect on the tree will be given in a later publication. It may be said here that the injury results directly from the feeding of the insect and the attendant injection of a substance of the same nature as that which in this group causes gall formation on the spruces. Apparently no microorganism is associated, as has been suggested by some, and the fungi which appear in the bark of dying trees are secondary.

Damage to the Forest

All sizes and ages of balsam fir are attacked. Severe injury has been found on good sites as well as poor sites, although vigorous trees recover more easily when the insect is removed. Trees in the open and trees in the shade become equally seriously infested when the insects are numerous. There is evidence, however, that some trees are more resistant than others in that a light infestation will rapidly die out on them. Severely injured trees will therefore be found close to others without any injury, particularly where the attack is not aggressive.

The injury known as "gout", which consists of swellings and distortions of the twigs and killing of the buds, is characteristic of the older infested areas in Nova Scotia and southern New Brunswick. Throughout this general region hardly any stands are free from it. Some have only slight injury and others have had a number of trees killed, or have up to 75% of the tops dead. This condition results from attack on the twigs over a number of years and there may be associated with it a light and practically invisible attack on the stem.

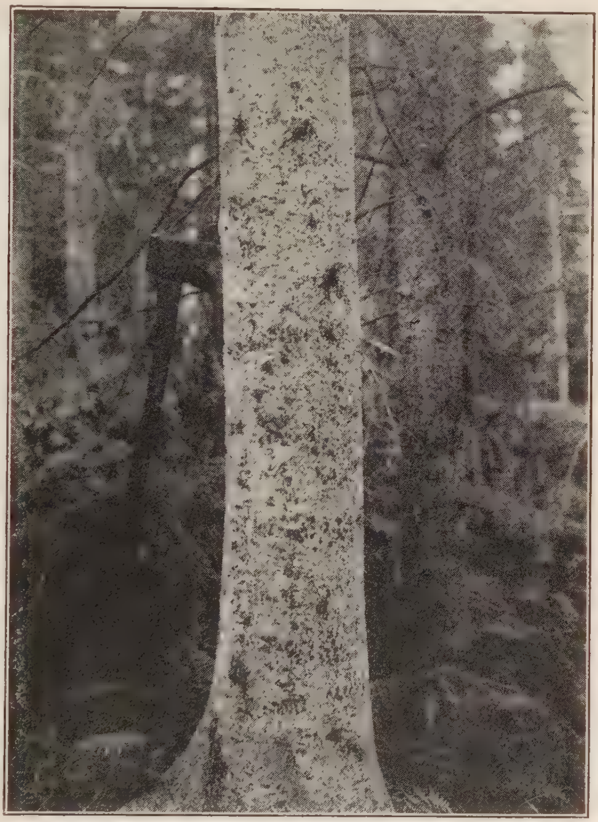

Figure 4. Heavy attack on stem of tree of 9 inches D.B.H.

Here and there are found small centres of heavy attack on the stem where the insects almost cover the bark and the trees are killed often without any appearance of "gout". Sometimes the twigs are completely free from the insect. Such areas are generally less than an acre in size. The attack starts at one point and gradually spreads from tree to tree, sometimes killing the greater part of the stand. The older trees with rough bark are generally attacked first. Small trees beneath them are severely infested and, as a rule, quickly killed by the larvae which fall from the larger trees.

This kind of attack is the one most characteristic of the edge of the infested area where the insect has apparently been recently introduced.

The extent and progress of the damage is being studied by means of a number of permanent sample plots. They indicate a slow but steady deterioration and mortality which are seriously affecting the value of fir as a producer of pulp and lumber.

Spread

The dispersal of the insect, in the absence of winged forms capable of reproduction, takes place in the egg or young larval stage. Once the larva has inserted its stylets it very seldom moves. It is, however, capable under certain circumstances, as are the later stages, of withdrawing its mouthparts and moving to a new location. This, however, is so rare in nature as to be negligible as a source of dispersal.

Experiments have shown that young larvae freshly emerged from the egg are blown considerable distances by strong winds and this is the chief method of dispersal. They are also capable of travelling from one tree to another over the ground and may be carried by man, birds, and squirrels and other animals.

Natural Control

One of the most important factors of control lies in the dying of all the insects on a tree when the tree itself dies.

Direct sunlight kills a good many owing to the heat at the surface of the bark and this is the explanation of the fact that trees with trunks exposed to the sun are free of infestation on the south side. Heavy rain also causes mortality. No evidence has been obtained that low temperature is directly responsible for any mortality although, as mentioned above, it stops development and eventually eliminates all but the *neosistens* larva in early winter.

No parasites are known. A number of native predators feed on the chermes, including syrphids, coccinellids, hemerobiids, an Agromyzid, an Anthocorid, a mite, and a lepidopterous larva, most of which are yet undetermined. None, however, has been found to be an effective agent of control. Some are themselves kept in close check by parasites and birds. Others do not seem capable of breeding up in satisfactory numbers, except on very heavily infested trees where the damage already has been done.

Through the co-operation of Dr. W. R. Thompson, Superintendent of the Farnham House Laboratory of the Imperial Institute of Entomology, the Dominion Parasite Laboratory has secured a considerable number of an Agromyzid, *Leucopis obscura* Trag., from Europe, where it is a valuable predator on *A. piceae*. Mr. A. B. Baird, in charge of the Dominion Parasite Laboratory, has forwarded a number of shipments of adults to New Brunswick where they have been liberated near Fredericton and Gagetown. They have been found overwintering within puparia in very satisfactory numbers.

Artificial Control

An active centre of heavy stem attack may be very satisfactorily checked by cutting the infested trees in winter when there are no eggs or motile larvae. The trees must either be utilized before spring or treated to prevent the larvae developing and laying eggs, as they are capable of doing on a cut tree. Bark scraping or singeing with a slash-burning blow torch will serve this purpose.

It will not be possible, however, to spot all infested trees, and complete extermination is difficult. The method should be attempted only with distinctly circumscribed outbreaks.

On ornamentals, very good control has been obtained by the use of miscible oil sprays thoroughly applied in the late winter or early spring before the first moult takes place. At this time there is less wool to protect the larvae. After they start to develop and cover themselves with wool, the spray is much less effective. Nicotine sprays are not recommended at any time.

Summary

A brief review is given of the history of *Adelges piceae* (Ratz.) in Europe as it bears on its recent behaviour in North America. The infested area, and the nature and extent of damage in Canada are described. A description and explanation of abnormalities caused by the insect is given. The life history is outlined, together with notes on dissemination, natural control and artificial control.

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COLOUR STRAINS OF THE DELICIOUS APPLE[1]

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INTRODUCTION

Within recent years considerable attention has been drawn to the appearance of red strains in several varieties of apples. The occurrence of these red strains is due to bud variations from the original variety. Variations in fruits have probably been occurring for ages, but it is only in the past few years, due to the enterprise of American nurserymen who have advertised several bud sports of important commercial varieties, that their commercial possibilities have become fully appreciated. This publicity has stimulated apple growers in both Canada and the United States to make diligent search for bud variations with the result that surprisingly large numbers have been found. Most of the known bud sports have to do with the colour of the fruit. This is probably due to the ease with which colour variations may be recognized. In the Delicious apple, numerous red bud sports have been found.

The literature contains several papers giving lists of varieties for which "red" sports have been reported (*6*, *7*, *25*). Descriptions of these variations are available. There are also well substantiated reports of bud variations affecting size, shape and russeting of fruits (*10*), also yield and size of trees (*9*, *23*). Detailed field studies have been made by certain workers (*11*). However, a careful search of the literature has failed to reveal any reference to a comparative study of the physical properties and chemical composition of fruit of a bud sport and its parent variety, with the exception of two previous publications from the Summerland Experimental Station, in which some preliminary studies comparing bud variations with their parents are reported (*20*, *21*).

What appear to be four distinct red sports of Delicious have been found in the Okanagan Valley in British Columbia. They occur as individual trees growing in commercial orchards at Salmon Arm, Vernon, Oyama and Winfield, respectively. Definite information as to their origin is lacking. The general indications are, however, that they are bud variations from the ordinary striped Delicious.

Owners of orchards in which these red strains were found reported that the fruit not only developed more red colour but coloured earlier in the season than the striped Delicious. This has been found to be true of other red strains elsewhere (*1*, *6*). It was said the red colour developed irrespective of exposure to sunlight. Since the present system of commercial grading is based largely on the percentage of red colour, it was argued that planting of the new strains would automatically ensure the production of higher percentages of Extra Fancy grade fruit. It was also maintained that fruits of the red strains have a longer storage life and that they may be picked in accordance with their correct ripeness due to the fact that they do not need

[1] Paper based on investigations conducted at the Dominion Experimental Station, Summerland, and the University of British Columbia, Vancouver, during 1930, 1931 and 1932.
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to be left on the trees until they reach an advanced stage of maturity in order to ensure high colour development.

There are, however, several possible disadvantages to this early colouring. Much of the popularity of red apples is due to the fact that high quality is usually associated with red colour. Extensive harvesting experiments carried on at the Summerland Experimental Station and also by other investigators (*16*) have shown that Delicious picked too early in the season develop inferior quality. It is probable that, due to the early colouring of the red strains, they may be harvested too early to allow for full development of dessert quality, with consequent unfavourable reaction on the popularity of the Delicious variety. Thus the question to be answered is: Do the new strains develop full red colour before sugar development and other chemical changes have progressed to the stage necessary to produce superior quality?

Figure 1. Striped (left) and red (right) strains of Delicious picked on the same date from individual branches grafted on the same tree.

Purpose of the Work

It was with the above problems in mind that harvesting and storage investigations reported in this paper were undertaken in the autumn of 1930 and continued in 1931 and 1932.

During this time, an attempt has been made to determine any difference physically or chemically between the fruit of the red strains and ordinary Delicious grown under exactly the same conditions and harvested at the same time. A study has been made of the relative storage behaviour of the two strains.

It was realized at the outset that the red sports may differ between themselves as regards colour development and other characteristics. It was further recognized that climatic and soil factors, as well as methods of

orchard management, may exert a considerable effect on the chemical composition of fruit. Consequently, it was decided to make tests simultaneously on four red bud sports of Delicious located in commercial orchards in the Salmon Arm, Vernon, Oyama and Winfield districts of British Columbia.

Source and Description of the Fruit

The four red strain trees were all comparatively healthy and making good growth The Salmon Arm tree was the oldest, being about twenty years old in 1930, while the Oyama tree was the youngest, being only eight years of age. The Salmon Arm and Vernon trees carried a good crop of fruit in all three years of the investigation. The Winfield and Oyama trees bore moderate crops in 1930 and 1932, but rather light crops in 1931.

The shape of the Delicious apple varied a good deal in the different districts. The fruit of the Winfield and Oyama orchards was often malformed, the apples being stubby and somewhat round, with the five characteristic points indistinct. These abnormalities in shape were apparently due to the soil and climatic conditions, as the fruits of the red and ordinary strains were similarly affected.

In 1932 a small quantity of fruit was obtained from Salmon Arm strains grown on the same rootstock at the Summerland Experimental Station.

Soil and Cultural Conditions

The soil in the Salmon Arm orchard is a fairly heavy clay while that in the Vernon orchard is a clay loam. At Oyama and Winfield the soil is a light shaley loam of a coarse sandy nature. Weeds have been allowed to grow up in every one of these orchards, being turned under sometime during the year. The trees in the Salmon Arm locality are non-irrigated, whereas those of the other three districts are irrigated, although the Oyama and Winfield trees seldom received an adequate supply of water. This probably accounts partially for the dullness in red colour of some of the fruit from these latter two districts. The natural precipitation is generally sufficient for the production of good fruit in the Salmon Arm orchard. Likewise more rain and cooler weather are experienced at Vernon than at Oyama and Winfield.

General Methods Employed

Methods of Taking and Handling Samples. For purposes of comparison, a tree of the striped variety of similar age, vigour and yield to the tree of the red strain was selected in each orchard. In 1930 from each of these eight trees, representative pickings were made on October 2, 9 and 16. At each picking, a hundred apples were harvested from each tree, care being taken to pick specimens representative of the colour development of the crop. Although the trees are growing in widely separated districts, it was found possible, by making a 270-mile motor trip, to have one investigator harvest fruit from all the trees and transport it to the Summerland Station on the same day.

The day following each picking, the apples were graded for skin colour, and twenty specimens from each tree tested for hardness and cut to ascertain flesh colour. Forty apples from each tree were held in common storage and another forty were placed in cold storage at 32° F. The cold storage lots were later used for chemical analysis.

In 1931 the complete crop from the eight trees was harvested on October 7 and 8, which dates were considered to be about the commercial picking dates for this variety. This was done in order to obtain sufficient material to make extensive tests of flesh colour as a maturity index and also to secure information regarding skin and flesh colour correlation. The fruit was handled as in 1930 with the exception that a much larger number of graded apples were cut to ascertain flesh colour, and greater quantities were placed in cold and common storage. Analyses were made of the apples of the different flesh colour grades.

In 1932 representative pickings were made of the Vernon and Oyama fruit on October 3, 10 and 17. Particular care was taken with these samples and it might be well to note here exactly how the pickings were made. On the first two dates, twenty apples were picked from the five sections of each tree—north, south, east and west, and the top portion—making a total of one hundred specimens from each tree. On the third picking, forty apples were taken from each part, as above described. Wherever possible, the twenty or forty specimens of each section were picked from the one limb. By taking representative samples in this manner, it was planned to eliminate as far as possible both the personal element and the variance naturally occurring in the fruit on the tree. At Salmon Arm and Winfield the complete crop was harvested on October 6 and 7 respectively. Numerous apples from the strains in these two districts were graded for flesh colour and analyzed. On the whole the fruit was handled as in the previous years and similar tests were made. However, a portion of a representative sample of the Vernon and Oyama fruit was analysed immediately on picking, the rest being stored at 32° F. and later removed to a ripening room for analysis in an eating ripe condition.

Also, in 1932, representative pickings were made on September 23 and 30, and October 14, of Salmon Arm red Delicious and ordinary Delicious, grown on the same rootstock at this station. These apples were analyzed at picking time. A small portion of the third picking, however, was cold stored and later analyzed when it had reached eating ripe condition.

In all three seasons, wherever possible, all pickings, records, and grading were done by the same individual in order to eliminate the personal factor as much as possible and to ensure comparable treatment of the fruit from all trees.

Examination for Inherent Tree Characteristics. A careful examination was made of the characteristics of trees of the red strains growing on clonal root systems to determine if they differed from one another or from the ordinary striped variety in such characters as foliage, colour of bark, numbers and form of lenticels, etc.

Methods of Chemical Analysis. The following chemical analyses were made on the fresh expressed juice each year: total sugars, reducing sugars, sucrose as invert, total acid, specific gravity, and Brix hydrometer reading. The percentage dry matter of the fruit was also determined in all cases. In 1930, sugar determinations were checked by analyzing alcoholic extractions of the apple tissues. In 1931 and 1932 the sugar and acid determinations were checked by analyses carried out on pasteurized samples of juices (*8*).

Conductivity values were determined in 1930; hydrogen ion or pH determinations were made in 1930 and 1931; the juice was analyzed for tannin in 1931 and 1932; respiration and water evaporation loss tests were conducted in 1931 and 1932.

For the expressed juice determination, care was taken to obtain uniform samples of juice. Twenty to thirty apples were quartered, the seeds discarded, and opposite quarters were passed through a common food chopper. Samples for dry weight and nitrogen determination were taken from this thoroughly mixed pulp. The pulp was then placed in a hand power press and the juice expressed. The analyses were begun immediately. The alcohol sugar extracts were obtained by extracting similar portions from each of six to eight representative specimens. Several methods in use for sugar determinations were tried. Benedict's volumetric method (*13*) and Shaffer and Hartmann's iodometric method (*24*), the latter proving somewhat superior to the former, were found to give good results, and were used in the early part of the work. However, the more recent method of Lane and Eynon (*14*) which has been adapted to analysis of sugars in apples by Evans (*12*) was the most satisfactory and was used entirely during the last year and one-half of the investigation.

For the estimation of free reducing sugars, the juice was clarified with neutral lead acetate and alumina cream, the surplus lead being removed with a saturated solution of sodium oxalate. Total sugars were determined upon a portion of the clarified solution by inverting with citric acid and employing the same method as for reducing sugars. When the Shaffer-Hartmann method was employed, hydrochloric acid was used for inversion.

Total titratable acidity, tannin, and nitrogen were determined according to the methods of the Association of Official Agricultural Chemists (*4*). The hydrogen ion (determined electrically with a Leeds and Northrup quinhydrone indicator) and the electric conductivity measurements (determined with a Leeds and Northrup potentiometer) were made on the freshly expressed juice. To determine the dry weight, 50 gms. of the sample of pulp were weighed into a tared metal dish, and dried in a well ventilated electric oven at 100° C. for 36 hours (*2*). Archbold (*3*) has recently found that slightly greater loss of weight than that due to the evaporation of moisture is obtained by this method owing to the decomposition of the sugars.

Method of Determining Rate of Respiration and Evaporation Loss of Fruit. The method of determining the rate of respiration of the fruit was essentially that used and described by Magness and Diehl (*15*). The carbon dioxide absorbed in the potassium hydroxide solution was measured by titrating 10 cc. aliquots of the potassium hydroxide solution according to the method of Blasdale (*5*). All determinations of the rate of respiration were made on fruit of Extra Fancy colour and medium size grade which had been previously held at 32° F. for about two months. The evaporation loss of the fruit was determined according to the method of Markley and Sando (*18*). Fruit of various size and colour grades which had been in cold storage for approximately two months was used in the tests.

Presentation of Results

Data, both chemical and physical, obtained in the course of the investigation, are summarized and presented in tables throughout the accompanying

discussion of the results. The comparisons are all made of the red and striped strains growing in the same orchards under similar conditions.

Hardness and Ground Colour of Fruit at Picking. Pressure determinations made with a mechanical pressure tester (*17*) did not reveal any significant difference in hardness between the red and striped strains grown under similar conditions. Hardness varies to some extent with colour and size grades. The smaller apples generally test higher than the large ones. Early in the picking season, Extra Fancy fruit may test harder than C grade, but again later in the season, C grade fruits may test higher than Extra Fancy.

The use of a ground colour chart, as a maturity index, was of little value with the new strains owing to the occurrence of red colouring over the entire Jonathan variety (*19*). However, in 1930 the maturity colour chart previously devised for use in harvesting the Jonathan variety (*19*) was tested on Delicious by using specimens which had some unblushed surface. The results recorded were in fair agreement with those obtained from other tests the same year.

Skin and Flesh Colour Grading of Delicious Strains. Skin Colour.—There was a marked difference in time and amount of red colour development. By having the same observer grade all the apples in this experiment into three classes to conform with the Canadian Government requirements for Extra Fancy, Fancy and C grade Delicious, which are: over 60%, 25 to 60%, and under 25% red colour, respectively, it was possible to secure comparable data. Some results of grading tne 1930 crop are presented in Table 1.

TABLE 1.—COLOUR GRADING OF DELICIOUS STRAINS

Picking date	Percentage extra fancy grade fruit	
	Red strains	Striped strains
October 2	83	5
October 9	90	22
October 16	94	45

The figures incorporated in the above table indicate the percentage of fruit with Extra Fancy colour, harvested from the striped and red strain trees at each picking date. It will be noted that the new red strains coloured earlier. The results of three years' investigations show that they grade for red colour 70 to 80% Extra Fancy from one to two weeks before 50% of the crop of the ordinary striped Delicious grade Extra Fancy.

As may be expected, there is some variance in the amount of red colour development in both red and striped strains on any one date from year to year. Also there is a slight variance in the amount of red colour developed by the different red strians. The Vernon sport had not in any year on the same date as high a percentage of red colour as the others. The greater

percentage of Extra Fancy grade fruit found in both strains at Oyama and Winfield in two of the years was probably due to the locality, soil and moisture conditions. There was a pronounced difference in quality of colouring in the individual red strains, fruits from the Salmon Arm and Vernon trees developing a bright scarlet colour, whereas those from Oyama and Winfield became a deep mahogany red.

Since most growers are well satisfied when half their crop of striped Delicious qualifies as Extra Fancy, it seems altogether probable that they are likely to pick the red strains at an earlier date than has been customary with the striped Delicious. That such a procedure may react to their disadvantage is shown by determinations of flesh colour, quality and chemical composition.

Flesh Colour. –As Delicious approach maturity on the tree, the flesh colour changes from a distinct green to a creamy yellow, passing through an intermediate stage of almost white colour. These flesh colours, going from green to yellow, are similar, though not identical, to Pale Chalcedony Yellow, Marguerite Yellow and Naphthalene Yellow as shown in Ridgway's Colour Chart (*22*). Data on the flesh colour of the fruit were secured by cutting across a number of apples from each picking from each tree and grading into three flesh colour classes, designated "green", "white", and "yellow". (See facsimile of colour chart, Figure 2.)

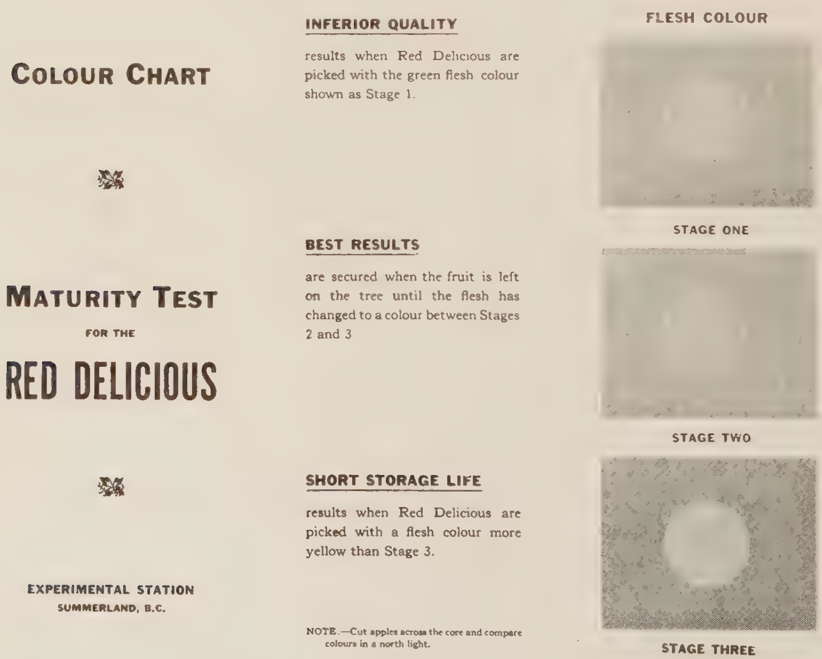

Figure 2. Facsimile of Flesh Colour Chart.

In Table 2, some of the data for the 1930 crop are summarized. They are indicative of the results secured in the following years.

TABLE 2.—FLESH COLOUR GRADING OF DELICIOUS STRAINS

Picking date	Percentage of fruit, with green flesh colour	
	Red strains	Striped strain
October 2	25	31
October 9	20	16
October 16	11	7

From the data presented in Table 2, it is apparent that the highest percentage of green-fleshed fruit in both strains appeared in the early pickings and decreased materially over the two weeks.

Flesh colour varied somewhat with size, but particularly with skin colour. In order to secure evidence regarding the correlation of flesh colour and skin colour, the same fruits which were cut across to determine flesh colour, were also graded for skin colour. Summarized data regarding the correlation of skin and flesh colour are recorded in the following table.

TABLE 3.—CORRELATION OF SKIN COLOUR AND FLESH COLOUR

Flesh colour	Percentage of extra fancy fruit	
	Reds strains	Striped strain
Green	28	0
White	32	32
Yellow	40	68

From Table 3 it is evident that by grading for skin colour in the ordinary Delicious, almost all of the green-fleshed fruits were placed in the C grade, whereas in the case of the red strains, 28% of the green-fleshed fruits developed sufficient red colour to qualify for the Fancy and Extra Fancy grades. Thus, grading for red colour practically eliminated the green-fleshed fruits from the Extra Fancy grade in the case of the striped Delicious, but not in the case of the red strains.

The significance of the fact that the red strains develop red skin colour before their flesh colour has progressed to the white or yellow stages, was revealed by quality determination during the storage period and by sugar analysis of the flesh colour grades. While the green flesh colour tends to bleach out somewhat after the fruit is picked, it was, nevertheless, found possible to grade stored samples into green, white and yellow flesh colours at the time when the fruit was considered to have reached prime eating condition. Since quality, as applied to apples, involves so many characteristics, and as the tastes of individual consumers differ, it is not easy to devise a satisfactory scale of quality. However, a record of the comparative excellence of a number of individual specimens was secured by classifying them as "good", "fair" and "poor". Several specimens from each tree from

each picking were sampled by the same observer. It was found in the two years in which three pickings were made over a period of two weeks, that the percentage of good quality fruit was higher in the second picking than in the first, and higher in the third than in the second. However, there was a wide range in quality even in apples picked from the same tree on the same day, especially in the first pickings. The correlation between flesh colour and quality, on the other hand, was found to be very close, most of the apples having green flesh colour being classed as poor in quality. The yellow-fleshed specimens on the whole developed the best quality. This suggests that early picking of the red strains may give apples of Extra Fancy skin colour but only C grade dessert quality.

Analytical Data. Sugar Content.—It was found that the red strains and ordinary Delicious maturing on comparable trees developed sugar at the same rate and in equal quantities with only very small variations. The early red colouring in the new strains was not accompanied by an early accumulation of sugar. Evidence substantiating this appears in Tables 4 and 5. They show that the red and ordinary Delicious from any one district had practically the same sugar content when harvested on the same date. The Salmon Arm red strain usually showed a slight indication toward a higher sugar content than the striped Delicious grown under similar conditions even when both strains were grown on the same rootstock at the Experimental Station, although in this latter case the difference is negligible and the results of only one year are obtainable. There is greater variance between the strains in the first year's results than in the following seasons. Moreover, variation in sugar content was not consistent each year, opposite results being secured in 1930 and 1931, whereas both strains from any one district had almost identical sugar contents in 1932. From Table 4 it is readily seen that the sugar content of ordinary striped Delicious varied to a great extent from one district to another and from year to year, whereas there was no significant difference in sugar content between red and striped strains grown in the same orchard under similar conditions and harvested at the same time.

TABLE 4.—TOTAL SUGAR CONTENT OF DELICIOUS STRAINS

Source of fruit	Year	Percentage sugar in fruit	
		Red strains	Striped strain
Salmon Arm	1930	16.3	15.3
Vernon		13.3	12.1
Oyama		11.3	12.5
Winfield		11.6	11.6
Salmon Arm	1931	13.40	13.04
Vernon		11.60	12.78
Oyama		13.64	13.55
Winfield		14.71	14.69
Salmon Arm	1932	14.48	14.92
Vernon		10.93	10.90
Oyama		10.93	10.46
Winfield		11.26	11.73
Experimental Station (Salmon Arm Strain)		13.23	13.00

The figures incorporated in Table 4 give the percentage of sugar in the red and striped strains of Delicious at the commercial picking time for ordinary Delicious in each of the three years of the investigation.

In Table 5, the close agreement in sugar content of the red and striped strains is further demonstrated. Also it is shown how the percentage sugar in the fruit gradually increased at the same rate in both the red and striped strains as the season advanced. This increase in total sugars was due primarily to an increase in sucrose.

TABLE 5.—INCREASE IN SUGAR CONTENT OF DELICIOUS STRAINS

Source of fruit	Percentage of sugar in fruit at each picking date					
	Red strains			Striped strain		
	Oct. 3	Oct. 10	Oct. 17	Oct. 3	Oct. 10	Oct. 17
Vernon	10.54	10.93	11.28	10.23	10.90	11.28
Oyama	10.27	10.93	11.35	10.11	10.46	11.41
*Experimental Station (Salmon Arm Strain)	10.83	11.60	13.23	10.79	11.37	13.00

*This fruit was picked on Sept. 23, 30, and October 14 respectively.

Slightly greater variance was found between the two strains in the first picking of the 1930 crop, the red strains with the exception of the Salmon Arm one, being somewhat lower in sugar content than the ordinary Delicious. This is probably due to the fact that elimination of the C grade fruit tha' year from the samples used for analysis removed the green-fleshed apples from the striped but not from the red strains. Data substantiating this statement are to be found in Table 6.

The results of analysis of fruit having green, white and yellow flesh colours are presented in Table 6. This analysis shows the fruits having these various flesh colours had a definite range in sugar content increasing appreciably as the colour of the fruit changed from green to yellow. It is apparent that there was no material difference in sugar content between red and striped strain fruit of the same flesh colour grade, whereas on the other hand, fruit of white flesh colour had significantly greater sugar content than fruit of green flesh colour, and fruit of yellow flesh colour had significantly greater sugar content than fruit of white flesh colour. The increase in total sugar of the yellow-fleshed fruit was due mainly to an increase in sucrose.

TABLE 6.—SUGAR CONTENT OF FLESH COLOUR GRADES

Flesh colour grade	Percentage sugar in fruit	
	Red strains	Striped strain
Green	12.44	12.67
White	12.91	13.26
Yellow	13.55	13.59

Acid Content.—The acidity varied but there was no consistent difference between red and striped strains with the possible exception of the Vernon red Delicious which showed a tendency to be slightly higher in total acid content than the ordinary striped type. The acidity decreased slightly by the end of the third picking in all strains, with the exception of the Vernon strains in 1932. Also fruit of yellow flesh colour showed a slightly lower acid content than fruit of green flesh colour.

There was no consistent difference between the red and ordinary Delicious in respect to hydrogen ion concentration and conductivity values. The pH averaged each year around 4.0 to 4.1 except in a few cases when the determinations were made on some very ripe samples. It was hoped by electrical conductivity tests to secure information regarding the comparative amounts of inorganic constituents present in the expressed juice, but the results were so inconsistent that these analyses were discontinued after the first season.

A few titration curves were constructed which showed the buffer action of the red and striped strains to be similar.

No significant or consistent differences were found between red and striped strains in the amounts of tannin and nitrogen present in the fruit. As great differences were noted between fruits of the striped strain from the several districts as between the two strains in the same orchard. Both the red and striped strains were rather low in tannin content, the juice containing usually 0.03 to 0.04% tannin. The nitrogen content of the flesh of the apples also ranged from about 0.03 to 0.04%.

Dry matter determinations were found to be an indication of the percentage sugar present in the apples. Specific gravity and Brix hydrometer readings served the same purpose.

Storage Behaviour. Information regarding the keeping qualities of the various strains was secured by examining the fruit held in common and cold storage when it had reached eating ripe condition. The hardness determination and maturity tests made by tasting the fruit showed no material difference in keeping quality between the red strains and ordinary Delicious grown under the same conditions and harvested at the same stage of maturity. Likewise, red and striped strains developed similar flavour and eating quality. A few samples of apples from all the strains were held continuously from time of picking till the middle of April at 32° F. They all kept well and by the latter part of April were still in good eating condition.

Analysis of Apples at the End of Storage. Complete analysis of apples at the end of storage in an eating ripe condition was obtained for the 1932 crop. The results of this analysis substantiate the data presented above with respect to the keeping quality of the red and striped strains. The analysis strongly indicates that the red and striped strains developed similar sugar and acid content in storage. There was an increase in total sugar and a decrease in total acid from the fruit analyzed at time of picking. It is worth noting that the increase in total sugar was due in the most part to an increase in sucrose. The development of sugar in the fruit during storage is summarized in Table 7.

TABLE 7.—DEVELOPMENT OF SUGAR IN STORAGE

Source of fruit	Percentage of sugar in fruit			
	Red strains		Striped strain	
	At picking time	At eating ripe stage	At picking time	At eating ripe stage
Vernon	10.93	13.10	10.90	13.30
Oyama	10.93	11.75	10.46	12.06
Experimental Station (Salmon Arm Strain)	13.23	15.76	13.00	16.23

Relation of Skin Colour and Quality. Table 8 shows the percentage of sugar in the various skin colour grades of the red and striped strains of Delicious apples when in prime eating condition.

TABLE 8.—RELATION OF SKIN COLOUR AND SUGAR CONTENT

Source of Fruit	Strain of Delicious	Skin colour Grade	Percentage		
			Reducing sugar	Sucrose as invert	Total sugar
Salmon Arm	Red	Extra Fancy	12.05	2.33	14.38
	Striped	Extra Fancy	12.39	2.43	14.82
		Fancy	12.00	2.38	14.38
		C	12.00	1.91	13.91
Winfield	Red	Extra Fancy	9.75	1.20	10.95
	Strlped	Extra Fancy	9.97	1.86	11.83
		Fancy	9.81	1.16	10.97
		C	9.67	0.88	10.55

From Table 8 it may be noted that the sugars are higher in the Fancy and Extra Fancy grade fruit. In this table also, it might be observed that the Extra Fancy apples of the red strains had a slightly lower sugar content than the same grade of fruit from the striped strain. This is undoubtedly due to the green-fleshed fruit in the red strains carrying sufficient red colour to qualify for the Extra Fancy grade . As previously mentioned, in the case of the striped strain, these green-fleshed fruits are practically eliminated from the Extra Fancy grade and fall, for the most part, into the C grade.

Respiration and Evaporation Loss Tests. The respiration tests showed the two strains to respire at practically the same rate. The evaporation loss of water through the skin, stem and calyx tube of the apples, showed no consistent differences.

Tree Characteristics. A careful examination of foliage, colour of bark, lenticels and general appearance revealed no characteristic differences between the red strains themselves nor the ordinary striped variety from which they sported.

Budding of ordinary striped Delicious and the Salmon Arm red strain on a clonal rootstock, No. 227, revealed an interesting difference between these two strains. The striped Delicious buds grew well and produced first grade trees in the nursery, but the Salmon Arm red strain showed unmistakable signs of uncongeniality with this particular rootstock, the young growth dying during the summer (Figure 3). Furthermore, the rootstocks themselves were killed. Death of these roots may have been due to starvation, but the fact that suckers sent up by the rootstocks failed to keep them alive suggests that some toxic substance may have been transferred to the rootstocks from the new growth produced by the red strain buds.

Figure 3. Striped (left) and red (right) strains of Delicious budded on clonal rootstock No. 227. Note that the red strain shows evidence of uncongeniality with this stock.

Discussion and Conclusions

The data accumulated during this three-year investigation of colour strains of the Delicious apple occurring in the Okanagan Valley of British Columbia, suggest the following conclusions.

There are red strains of Delicious which colour earlier and produce a much higher percentage of Extra Fancy coloured fruit than the original striped variety. It is also apparent, from flesh colour determinations and chemical analysis, that this earlier development of red colour is not altogether an advantage. In the ordinary Delicious, red colour has provided a fairly reliable criterion of the quality of the fruit. However, the red colour of these four new strains develops in advance of sugar accumulation. This is decidedly

a disadvantage in that high sugar content is a requisite characteristic of prime Delicious, and premature harvesting of the red strains is thus likely to give apples which will meet Extra Fancy colour requirements but be of only C grade quality. For this reason, it is imperative that growers take special precautions to harvest the red strains at the proper stage of maturity to ensure maximum quality. This is the same time for both red and striped strains, namely at the time when about 50% of the striped Delicious grade Extra Fancy.

The flesh colour of the fruit has proved to be a comparatively reliable index of maturity. Flesh colour is easy to determine after a little practise and is readily adaptable to field tests as it is only necessary to cut across and examine a few representative apples from each tree. It is best to examine the flesh colour in a north light. A chart showing three flesh colour stages has been prepared (Figure 2). Evidence has been secured that the time when the flesh colour of the fruit is turning from white towards yellow, is the ideal picking stage.

Red Delicious, picked at the proper stage of maturity, are pleasing to the eye, and develop just as excellent quality as the ordinary striped strain grown under similar conditions. Furthermore at this stage they grade close to 100% Extra Fancy.

Summary

1. A comparative study, both physical and chemical, was made over a three-year period, of four distinct red bud variations of the Delicious apple and the ordinary striped strain from which they originated.

2. The new red strains coloured earlier and to a greater extent than the ordinary Delicious. This red colouring developed to some extent irrespective of exposure to sunlight.

3. The results of pressure tests, pH, conductivity, tannin and nitrogen determinations, titration curves, respiration and evaporation loss tests, revealed no significant differences between the red and striped strains.

4. The early red colouring in the new strains was not accompanied by an early accumulation of sugar. In other words, high colour is not necessarily associated with a high sugar content.

5. The fruit of the red strains and ordinary Delicious maturing on comparable trees, developed sugar at the same rate and in equal quantities with only very small variations.

6. The acidity varied but there was no consistent difference between red and striped strains.

7. There was no material difference in keeping quality between the strains. Grown under uniform conditions, the red and striped strains developed similar sugar and acid content in storage. Total sugar increased up to a certain point while total acid gradually decreased.

8. Flesh colour was found to be a reliable index to maturity. The three flesh colours, designated "green", "white", and "yellow", were compared with colours in Ridgway's Colour Chart, and found to be similar, though not identical to, Pale Chalcedony Yellow, Marguerite Yellow and Naphthalene Yellow, respectively.

9. Fruit of yellow flesh colour was higher in sugar content than fruit of white flesh colour, and fruit of white flesh colour was higher than that of green flesh colour. The increase in total sugar going from green to yellow-fleshed fruit was due mostly to an increase in sucrose.

10. Green-fleshed fruit developed poor quality, whereas the yellow-fleshed specimens on the whole developed the best quality.

11. The highest percentage of green-fleshed fruit appeared in the early pickings and decreased materially over each succeeding week. Furthermore, in grading for skin colour in the ordinary Delicious, almost all of the green-fleshed fruits were placed in the C grade, whereas in the case of the red strains, many of the green-fleshed fruits developed sufficient red colour to qualify for the Fancy and Extra Fancy grade.

12. Extra Fancy grade fruit of both the red and striped strains of Delicious had a higher sugar content than the C grade fruit. Also the Extra Fancy apples of the red strains showed a slightly lower sugar content than the same grade of fruit from the striped strain, due, in all probability, to the green-fleshed fruit in the red strains.

13. Tree growth characteristics were similar in all strains, but propagation of red and striped strains on a clonal rootstock revealed a difference in congeniality with this stock.

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THE ECONOMIC SITUATION

PREPARED IN THE AGRICULTURAL ECONOMICS BRANCH, DEPARTMENT OF AGRICULTURE, OTTAWA, FROM BASIC DATA COLLECTED BY THE DOMINION BUREAU OF STATISTICS

The usual discussion of the economic situation as revealed by current index numbers of prices and production, supplemented by other statistical data has been omitted from this issue although the indexes for the month of January have been added. This has been done in order to focus the attention of the readers of *Scientific Agriculture* upon the fact that a somewhat comprehensive analysis of the Agricultural Situation has been prepared by the officers of the several Branches of the Department of Agriculture, the Commercial Intelligence Service, and the Dominion Bureau of Statistics. This first review, which it has not been possible to issue at an earlier date, will be available shortly after the first of March. It is intended that the report will be made annually and distributed in time to be used as a basis for production planning. It will be realized that the references given here are very brief and that the complete statement should be read in order that the full weight of the different factors may be more apparent.

Domestic Demand.—In regard to Domestic Demand the report states: "Recent improvement in general business conditions in Canada gives ground for some degree of confidence with regard to the domestic market for Canadian farm products. Present indications do not warrant any expectation of a rapid rise in prices of agricultural produce. Nevertheless there has been some advance in recent months after a period of almost uninterrupted decline. Certain developments support the view that the demand for the farm products of Canadian farms should show moderate improvement in the immediate future." Among these are the substantial rise in the indexes of wholesale prices in general and of Canadian farm products, a steadily increasing volume of industrial production, improved employment conditions, fewer business failures, lower storage stocks of agricultural products, and some increase in retail sales.

Foreign Demand.—In the analysis of foreign demand emphasis is placed upon the fact that 70% of our exports of agricultural products were marketed in the United Kingdom in 1933. The recent improvement in employment and business activity along with the building and reconstruction programmes under way gives hope of some improvement in this market in 1934. What is true of United Kingdom is also true of most continental countries, though the disturbed international political situation is recognized as an unfavourable factor. The tendency to nationalistic trade barriers in the form of tariffs, price fixing agreements, quotas and exchange controls is also regarded as one of the less favourable signs. It is pointed out, however, that the extent to which such barriers curtail international trade is being more generally recognized and this is a favourable sign although it is believed that the withdrawal of such impediments to trade must be gradual. In general, foreign competition will continue to be intense though rising world prosperity would remove some of the causes of protective measures for farmers and gradually some of the forces which at p esent make for extreme competition.

Grains.—Four years of relatively low prices has not materially affected the total acreage sown to grain in Canada. There has been a noticeable shift from the production of barley, rye, flax, and buckwheat to wheat, oats, and corn. "With the exception of wheat, stocks of grain will be relatively low at the end of July. As long as a wheat surplus persists in Canada, farmers should consider the possibilities of marketing the lower grades through live stock. Wide spread drought during recent years has indicated the advantage of maintaining a reserve of feed grains and odder on the farm. In view of an existing surplus of wheat, a portion of the land normally

ANNUAL AND MONTHLY INDEX NUMBERS OF PRICES AND PRODUCTION
COMPUTED BY DOMINION BUREAU OF STATISTICS

Year	Wholesale Prices 1926 = 100				Retail prices and cost of services (5)	Production (6) 1926 = 100			
	All commodities (1)	Farm products (2)	Field products (3)	Animal products (4)		Physical volume of business	Industrial production	Agricultural marketings	Cold Storage holdings
1913....	64.0	62.6	56.4	77.0	65.4	....	....	....	....
1914....	65.5	69.2	64.9	79.0	66.0	....	....	....	....
1915....	70.4	77.7	76.9	79.2	67.3	....	....	....	....
1916....	84.3	89.7	88.4	92.3	72.5	....	....	....	....
1917....	114.3	130.0	134.3	119.6	85.6	....	....	....	....
1918....	127.4	132.9	132.0	134.7	97.4	....	....	....	....
1919....	134.0	145.5	142.4	152.5	107.2	71.3	65.5	48.1	47.1
1920....	155.9	161.6	166.5	149.9	124.2	75.0	69.9	52.6	94.2
1921....	110.0	102.8	100.3	108.5	109 2	66.5	60 4	65.2	86.4
1922....	97.3	86.7	81.3	99.1	100.0	79.1	76.9	82.6	82.6
1923....	98.0	79.8	73.3	95.1	100.0	85.5	83.8	91.4	87.8
1924....	99.4	87.0	82.6	97.2	98.0	84.6	82.4	102.5	114.6
1925....	102.6	100.4	98.1	105.7	99.3	90.9	89.7	97.2	108.9
1926....	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1927....	97.7	102.1	99.9	105.7	98.4	106.1	105.6	103.6	110.0
1928....	96.4	100.7	92.6	114.3	98.9	117.3	117.8	146.7	112.8
1929....	95.6	100.8	93.8	112.5	99.9	125.5	127.4	101.1	109.6
1930....	86.6	82.3	70.0	102.9	99.2	109.5	108.0	103.0	128.4
1931....	72.2	56.3	43.6	77.6	89.6	93.5	90.4	99.0	125.7
1932....	66.7	48.4	41.1	60.7	81.4	78.7	74.0	114.3	120.1
1933(7).	67.2	51.0	45.7	60.9	78.0	79.2	76.8	105.1	115.4
Jan.....	63.9	43.6	35.1	57.9	79.1	68.1	62.2	56.1	112.0
Feb.....	63.6	43.0	36.0	54.7	78.4	67.0	60.9	76.5	127.6
Mar.....	64.4	44.7	38.0	56.0	77.8	68.4	62.5	129.0	135.8
April...	65.4	46.8	41.1	56.4	78.1	69.8	65.1	104.1	112.7
May....	66.9	51.2	46.9	58.4	77.0	76.4	72.7	95.4	100.4
June....	67.6	52.6	49.4	57.9	77.0	82.2	79.8	221.9	119.9
July....	70.5	60.1	60.8	59.0	77.2	84.1	82.6	136.3	114.5
Aug.....	69.4	57.0	54.9	60.5	78.6	89.8	89.5	197.2	114.2
Sept....	68.9	54.7	49.5	63.4	78.8	90.8	90.2	101.1	115.7
Oct.....	67.9	51.4	44.6	62.8	77.9	88.2	87.4	70.5	112.7
Nov....	68.7	53.8	46.7	65.8	78.1	85.5	83.9	41.8	111.1
Dec.....	69.0	53.3	45.3	66.6	78.4	86.2	85.1	30.7	107.6
1934:									
Jan.....	70.6	55.3	47.9	67.8	78.7	86.8	84.5	48.2	108.1

1. See Prices and Price Indexes 1913-1928, pp. 19-21, 270-289 and 1913-1932, p. 15.

2. Wholesale prices of Canada products of farm origin only. See Prices and Price Indexes 1913-1931, p. 33, and Monthly Mimeographs 1932 and 1933.

3. Wholesale prices of grains, fruits and vegetables.

4. Wholesale prices of Animals and Animal Procudts.

5. Including foods, rents, fuel, clothing and sundries, See Prices and Price Indexes 1913-1928, pp. 181-185, 290-293. 1926 = 100.

Prices and Price Indexes 1913-1931, pp. 122, and Monthly Mimeographs 1932-1933.

6. Monthly Review of Business Statistics, pp. 8, and Monthly Indexes of the Physical volume of business in Canada, supplement to the Monthly Review of Business Statistics, November, 1932.

7. Preliminary.

sown to wheat might advantageously be used in the production of needed and reserve feed supplies." Present low stocks of oats, barley, flax and rye would seem to indicate the desirability of some increase in the acreage of these crops.

Seeds.—Increased production of red clover seed is recommended because there is a good demand in both the domestic and foreign markets. Expansion of the acreage of alfalfa warrants increased seed production in favourable areas. The demand for alsike is "critical"; only high grade seed can be moved into the export markets. Sweet clover seed is easily produced in excess of home market requirements and there

is little export outlet under present conditions. There is still a deficiency of domestic timothy seed and some increase may be warranted.

Beef Cattle.—The trend of beef cattle production is upward, particularly in Western Canada. Prices were very low in 1933. In regard to the proposed restriction of imports into the United Kingdom the report states: "In effect it should also mean more satisfactory prices for Canadian exports. This move indicates very clearly, however, that in the United Kingdom the policy is to place all imports of meats, irrespective of origin on a quota basis. . . . It is felt that the interests of both countries will be best served by Canada observing the strictest precautions in respect to the selection of stock for export."

Hogs.—The hog situation is summarized as follows: "The outlook for hogs appears to be favourable to the producer. It is likely that there will be some temporary price declines during the present year but the trend is upward. Market supply prospects are for a moderate volume during the first half of the year, followed by a fairly substantial increase." Despite the present favourable export outlook improvement in breeding, feeding, selection and pack so as to secure a large percentage of top grades of bacon is much more desirable than an increase in general production. The domestic market should show improvement during the present year.

Milk Production.—There was little change in the volume of milk produced in 1933 as compared with that in 1932. The number of milch cows was estimated to have been 3,753,400 in 1933, an increase of 27,900 over the previous year. This increase has been general except in Alberta and British Columbia. The number of dairy heifers has also increased particularly in the Prairie Provinces. Since the milch cow and dairy heifer population is high, production may be expected to be maintained at about the same level as in 1933. This, of course, depends on the extent to which price relationships of agricultural products change.

Butter.—Butter production in 1933 was slightly above that for 1932. Imports were higher than during the preceding year but not as high as in 1931. Consumption of butter in Canada was therefore somewhat above that for 1932. Prices at Montreal were also above the level of the previous year.

Cheese.—Cheese production was approximately 12,600,000 pounds lower than in 1932. There was a decrease of 2.3% in Ontario and Quebec in which provinces 96.5% of Canadian cheese was produced in 1933. Exports have naturally been lower and domestic consumption was about the same as in 1932. Some emphasis is placed upon the intense competition among exporters of dairy products in the United Kingdom market.

Apples.—Increasing production of apples in the province of Quebec, intense competition in the United Kingdom market and curtailment of production of Gravensteins in Nova Scotia, Fameuse in sections of New Brunswick, Quebec and Ontario and Wealthy in Quebec, Ontario and British Columbia are features of the discussion of the apple situation.

Pears.—There appear to be good prospects for increased production of Bartlett pears. Experience in recent years has demonstrated that there is a good demand for canned Bartlett's in both domestic and foreign markets.

Potatoes.—Farmers usually respond to higher prices by increasing acreage, but a materially increased acreage for the commercial areas in 1934 may have a depressing effect on prices. Plantings should be confined to favoured areas where good seed is available. Consumption seems to have changed but little during the past few years and it may be assumed that an average production from a slightly higher acreage will probably be absorbed in 1934-35 without much change in prices.

Vegetable Canning Crops.—Canning requirements in 1934 will likely be normal in most lines with the possible exception of corn. Those favourably situated should consider the possibilities of increasing production of asparagus.

LA SITUATION ECONOMIQUE

PREPARE PAR LA DIVISION DE L'ECONOMIE AGRICOLE DU MINISTERE DE L'AGRICULTURE, OTTAWA, ET BASE SUR LES DONNEES RECUEILLIES PAR LE BUREAU FEDERAL DE LA STATISTIQUE

L'analyse habituelle de la situation économique telle qu'indiquée par le tableau des chiffres-indices des prix et du volume de la production, complétée par d'autres données statistiques a été omise dans ce numéro bien que les chiffres-indices pour le mois de janvier aient été ajoutés à ce tableau. Ceci, afin d'attirer l'attention des lecteurs de la Revue Agronomique Canadienne sur le rapport préparé conjointement par les diverses Divisions du Ministère de l'Agriculture, le Service des Renseignements Commerciaux et l'Office Fédéral de la Statistique. Cette première revue de la situation agricole au Canada sera disponible dans la première semaine de mars cette année, mais à l'avenir elle sera publiée un peu plus tôt et les agriculteurs pourront s'en inspirer plus efficacement pour élaborer leur programme agricole de l'année courante. Nous donnons, présentement, un bref résumé de cette revue de la situation agricole, mais pour avoir une vue d'ensemble et juger de l'influence des divers facteurs, il faudrait consulter le rapport complet.

Demande domestique. Pour ce qui concerne la demande domestique le rapport dit: "l'amélioration récente de la situation générale des affaires au Canada semble inspirer un regain de confiance dans le marché domestique pour les produits de ferme, mais ces indices ne justifient pas l'attente d'une hausse rapide des prix des produits agricoles; cependant, l'arrêt de la dégringolade des prix presque constante depuis quatre ans et, dans certains cas, une hausse légère des prix durant les derniers mois fournissent des motifs d'encouragement et laissent entrevoir que la demande des produits agricoles canadiens devrait être meilleure prochainement." Parmi ces signes, on peut noter la hausse substantielle qui s'est produite dans l'indice des prix de gros en général et des produits agricoles canadiens, un accroissement régulier du volume de la production industrielle, des conditions meilleures d'emploi et de travail, des faillites commerciales moins nombreuses, des réserves moins fortes de denrées agricoles en entrepôts, et quelques augmentations dans les ventes au détail.

Demande étrangère. Dans l'analyse de la demande extérieure ou étrangère, on attribue une certaine importance à ce que 70 pour cent de nos exportations de produits agricoles furent écoulés dans le Royaume-Uni en 1933. L'amélioration récente qui s'est produite dans le situation de l'emploi, une plus grande activité dans les affaires, la reprise de la construction et l'application de programmes de restauration économique laissent entrevoir des améliorations possibles dans le marché anglais pour l'année 1934. Ceci s'applique aussi à la plupart des pays continentaux, quoique le bouleversement de la situation politique constitue un facteur défavorable dans ces cas. Le nationalisme économique qui se traduit en pratique par l'imposition de barrières douanières, les conventions commerciales, les contingentements d'exportation, le contrôle du change, est aussi considéré comme un signe défavorable. Cependant, comme on commence à s'apercevoir que tous ces obstacles au commerce international retarde la reprise des affaires dans tous les pays, il se peut qu'on en atténue graduellement la rigueur mais cela peut-être assez long. En général, la concurrence étrangère continuera d'être vive, bien que le retour à la prospérité mondiale pourra motiver le retrait de certaines mesures de protection établies dans l'intérêt momentané des agriculteurs ainsi que l'atténuation des causes qui intensifient actuellement la concurrence à un degré extrême.

Grains. Les prix relativement bas obtenus pour les céréales durant les quatre dernières années n'ont pas causé une réduction substantielle de la superficie totale ensemencée en grains au Canada. Il y a eu cependant un changement sensible dans la production relative des divers grains; les ensemencements d'orge, de seigle, de lin

et de sarrasin ont été diminués et on y a substitué le blé, l'avoine et le maïs. "Sauf pour le blé, les stocks de grains seront relativement bas à la fin de juillet. Aussi longtemps qu'il y aura un excédent de blé au Canada, les cultivateurs devraient considérer les possibilités d'utiliser le blé de qualité inférieure comme aliments pour le bétail. Les périodes de sécheresse dans maintes régions durant les dernières années démontrent les avantages qu'il y a de maintenir des réserves de grains d'alimentation et de fourrages sur les fermes. Etant donné qu'il existe actuellement un excédent de blé, une partie du terrain consacré ordinairement aux ensemencements de blé pourrait être utilisé avantageusement pour la production des aliments du bétail requis chaque année ainsi que pour constituer certaines réserves." Les faibles stocks actuels d'avoine d'orge, de lin et de seigle semblent indiquer qu'il serait bon d'augmenter quelque peu les superficies de ces récoltes.

Semences. L'augmentation de la production de la graine de trèfle rouge est recommendable, parce que la demande est bonne, tant sur les marchés domestiques qu'étrangers. Une certaine expansion dans l'établissement de luzernuères justifie l'augmentation de la production de la graine de luzerne dans les régions favorables pour cette récolte. La demande pour le trèfle d'alsike est très faible et seule la graine d'alsike de bonne qualité peut être exportée. La graine de trèfle d'odeur est facilement produite en excès des besoins domestiques et, dans les conditions actuelles, il existe peu de débouchés pour l'exportation. La production de la graine de mil au Canada est insuffisante pour les besoins domestiques et la production pourrait en être augmentée raisonnablement.

Bétail de boucherie. La production du bétail de boucherie a une tendance à la hausse, particulièrement dans l'Ouest du Canada. Les prix furent très bas en 1933. Comme on a l'intention d'imposer certaines restrictions sur les importations dans le Royaume-Uni, le rapport fait les commentaires suivants: "Ceci signifie que les prix devraient être plus satisfaisants aussi pour les exportations du Canada. Cette mesure indique clairement, cependant, que la politique du Royaume-Uni est d'instituer des contingentements sur toutes les importations de viandes, sans tenir compte du pays d'origine. . .. . "Il semble que ce serait dans le meilleur intérêt des deux pays de faire le choix de notre stock d'exportation avec le plus grand soin."

Porcs. La situations de l'industrie porcine est résumée comme suit: "Les perspectives semblent favorables aux éleveurs de porcs. Les prix subiront probablement certaines baisses temporaires durant l'année courante, mais la tendance est à la hausse. D'après ce qu'on peut voir, les envois de porcs sur les marchés seront modérés durant la première moitié de l'année et augmenteront substantiellement par la suite." . . . . En dépit des perspectives actuelles favorables pour l'exportation, l'amélioration des méthodes d'élevage, d'alimentation, de selection et d'emballage, de façon à obtenir un fort pourcentage de bacon d'excellente qualité, est plus recommendable que l'augmentation de la production en général. Le marché domestique devrait s'améliorer au cours de l'année.

Production laitière. Il y eut peu de changement dans la quantité de lait produite en 1933 comparativement avec l'année 1932. Le nombre de vaches laitières estimé à 3,753,400 en 1933 montre une augmentation de 27,900 sur l'année précédente. Cette augmentation fut générale, sauf pour l'Alberta et la Colombie Anglaise. Le nombre de génisses laitières a aussi augmenté, principalement dans les provinces de l'Ouest. Comme la population des vaches et des génisses laitières est élevée, la production laitière sera probablement maintenue à peu près au même niveau que durant l'année 1933. Naturellement, ceci dépend dans une certaine mesure des changements relatifs qui se produiront dans les prix des divers produits agricoles.

Beurre. La production du beurre en 1933 fut légèrement supérieure à celle de 1932. Les importations furent plus fortes que pour l'année précédente, mais pas aussi considérables qu'en 1931. La consommation du beurre au Canada fut, néan-

moins, un peu plus élevée qu'en 1932. Les prix de cette denrée à Montréal furent aussi à un niveau plus élevé que l'année précédente.

Fromage. La production du fromage fut envrion de 12,600,000 livres plus faible qu'en 1932. Il y eut une diminution de 2.3 pour cent dans les provinces d'Ontario et de Québec, lesquelles fabriquèrent 96.5 pour cent de la production totale du fromage canadien en 1933. Les exportations furent naturellement plus faibles et la consommation domestique à peu près la même qu'en 1932. On attache assez d'importance à la concurrence intense que se font les exportateurs de produits laitiers sur le Royaume-Uni.

Pommes. L'augmentation de la production des pommes dans le Québec, la concurrence active sur le marché du Royaume-Uni, l'opportunité d'une certaine réduction de la production de la pomme Gravensteins en Nouvelle-Ecosse, de la Fameuse dans certaines régions du Nouveau-Brunswick, du Québec et de l'Ontario ainsi que de la Wealthy dans le Québec, l'Ontario et la Colombie sont les principaux points saillants de l'analyse de la situation de la pomiculture.

Poires. Il semble y avoir de bonnes perspectives pour une augmentation de la production de la poire Bartlett. L'expérience des denrières années nous a démontré qu'il existe une bonne demande pour les poires Bartlett mises en conserve, tant sur le marché domestique que sur les marchés étrangers.

Pommes de terre. Les cultivateurs sont naturellement inclinés à augmenter leurs plantations de pommes de terre quand les prix pour la récolte précédente ont été plus élevés que d'ordinaire, mais une augmentation substantielle des superficies ensemencées en pommes de terre en 1934 dans les régions où l'on fait cette culture principalement pour le commerce pourrait fort bien avoir un effet défavorable sur les prix l'automne prochain. Les plantations devraient donc être limitées en quelques sorte aux régions favorables à cette culture et où l'on peut se procurer de bonnes semences. La consummation de pommes de terre ne semble pas avoir varié beaucoup durant les années passées et l'on peut croire qu'une récolte moyenne, sur une étendue légèrement plus grande, sera probablement absorbée en 1934-35 sans grands changements dans les prix

Légumes pour la mise en conserve. Les besoins d'approvisionnement de conserve en 1934 seront probablement à un niveau normal pour la plupart des espèces de légumes, sauf le blé d'Inde. Ceux qui sont situés dans des conditions favorables pourraient peut-être trouver avantageux d'augmenter leur production d'asperges.

RESUME DES ARTICLES PUBLIES EN ANGLAIS DANS CE NUMERO

LA PHILOSOPHIE D'UN AGRICULTEUR. E. A. Howes, Doyen de la Faculté d'Agriculture, Université de l'Alberta, Edmonton.

Cette causerie fut faite lors du banquet annuel de la C.S.T.A. et des anciens élèves du Collège de Guelph à Toronto en novembre dernier.

L'auteur y fait ressortir le besoin de recherches économiques précises et d'organisation coopératives de vente. Les problèmes de la production eux-mêmes ne sont pas encore résolus. L'auteur avait un jour déclaré à un congrès de la C.S.T.A.: "Si nous pouvons éduquer nos cultivateurs à produire la chose convenable au bon moment et de la façon qu'il faut, nous aurons résolu un des plus gros problèms de la vente." Les nouveaux types de machinerie ne devraient pas être adoptés avant d'avoir été examinés à fond pour voir s'ils sont adaptés aux besoins de la pratique. Une politique agricole à soubresauts est rarement profitable. La causerie se terminait par les mots suivants "La pire chose qu'on puisse léguer aux jeunes est une tendance à se plaindre de leur sort. . . . . Si je pouvais en brandissant quelque bâton magique changer de place avec n'importe lequel de nos jeunes gens d'aujourd'hui, j'échangerois volontiers se jeunesse contre ma position. Je voudrais de nouveau pouvoir être jeune."

Lignees se rapportant a des variations de couleur dans les pommes Delicieuses. C. C. Strachan, Ferme Expérimentale Fédérale, Summerland, B.C.

L'auteur a fait une étude comparative pendant une période de plus de trois années sur des pommes Délicieuses, comparant avec des pommes normales de la variété quatre lignées de pommes rouges qui en sont dérivées par mutation. Les lignées rouges se colorent plus tôt et davantage que les Delicieuses ordinaires. Au moins dans une certaine mesure, cette couleur rouge se développe indépendamment de l'exposition au soleil. Des mesures de la résistance à la pression, du pH, de la conductivité, de la teneur en tanin et en azote, de la respiration et de la perte de poids par évaporation n'ont montré aucune différence significative entre les lignées ordinaires et les lignées rouges. La coloration hâtive des lignées rouges ne s'accompagne pas d'une accumulation hâtive de sucre. En d'autres termes la couleur n'est pas nécessairement associée à la teneur en sucre. Un examen dè fruits rouges et de fruits normaux mûrissant en même temps sur des arbres comparables a montré que tous ces fruits forment leur sucre en même temps et dans les mêmes proportions. Les variations dans l'acidité ne sont pas consistanses. Les qualités de conservation sont les mêmes. Produits dans des conditions uniformes, les fruits des lignées rouges et des lignées normales développent les mêmes quantités de sucre et d'acide pendant l'emmagasinage. Le sucre total augmente jusqu'un certain point pendant que l'acide total diminue graduellement. La couleur de la chair donne une indication satisfaisante de la maturité. Les trois couleurs de la chair communément appelées "verte", "blanche", et "jaune", comparées aux couleurs standard de Ridgway, ont été trouvées similaires, mais non identiques, aux couleurs suivantes:— "Jaune chalcédoine pale", "jaune marguerite" et "jaune de naphthalène". La teneur en sucre des fruits augmente graduellement de la chair verte à la chair jaune. Cette augmentation du sucre total est due principalement à une augmentation du sucrose. Les fruits à chair verte ont donné une qualité inférieure tandis que dans l'ensemble ce sont les spécimens à chair jaune qui one donné la meilleure qualité. Le plus haut pourcentage de fruits à chair verte a été obtenu lors des premiàrs cueillettes et le pourcentage de chair verte a diminué avec les cueillettes successives. Lors de la clasification des Délicieuses ordinaires, presque tous les fruits à chair verte ont été placés dans la classe "C" tandis que dans le cas des variétés rouges certains des fruits à chair verte ont dévéloppé suffisemment de couleur pour être placés dans les classes "fancy" et "extra fancy". Les fruits extra fancy provenant des lignées rouges aussi bien que normales ont été trouvés contenir plus de sucre que les fruits de la classe "C". Les pommes "extra fancy" des lignées rouges ont montré un peu moins de sucre que les pommes de même classe provennant de lignées normales, ce qui probablement est dû à la présence de fruits à chair verte parmi les lignées rouges. Les caractéristiques de croissance des arbres sont similaires dans toutes les lignées mais leur propagation sur un sujet du même groupe révèle une différence quant à leur affinité pour ce sujet.

NOTES AND NEWS

PHILOSOPHY FROM AN AGRICULTURIST

In agricultural circles it has become customary to recognize Dean Howes of Edmonton as the "Dean of Deans." He is the senior among the heads of agricultural colleges in Canada, both in age and in years of service. While it may be true that some of our technical agriculturists become swamped with the routine of administrative duties, or the intricacies of scientific investigations, Dean Howes always keeps before us the needs and the aspirations of that sometimes-forgotten man, the farmer.

From time to time he gives us glimpses of the early days. At the Royal Fair last November he combined reminiscences, agricultural economics, and philosophy in an address which is printed in this issue of *Scientific Agriculture*. The manuscript of a book by Dean Howes containing much similar material is in the hands of a Canadian firm which is waiting only for improved business conditions before publishing. In the meantime, those who are able to tune in on the Western network of the Canadian Radio Commission may hear Dean Howes on the evenings of March 8th, 15th, and 22nd.

BOWLING TOURNAMENT

The second series of the five-pin bowling tournament conducted by C.S.T.A. locals in Ontario and Quebec was rolled during the week of February 12th. Four locals participated with the following results:

1. Average Scores for whole evening:

Toronto	27 players	Average 2 games	185.3
Montreal	9 "	" 3 "	174.4
Ottawa	24 "	" 3 "	165.4
Niagara	10 "	" 4 "	165.1

2. Average Scores on basis of 2 games:

Montreal	9 players	Average for 2 games	188.2
Niagara	10 "	" " 2 "	187.2
Toronto	27 "	" " 2 "	185.3
Ottawa	24 "	" " 2 "	181.1

3. Best Five Players on basis of 2 games:

Toronto	(McPhee, Whitelock, McRostie, Hodge, Nixon)	230.1
Ottawa	(Grindley, Booth, Bentham, Cowan, Chepeswick)	224.7
Niagara	(Dustan, Palmer, Robb, Upshall, Chamberlain)	211.0
Montreal	(Asher, Evans, Lanctot, Lefèvre, McGowan)	205.1

4. High individual scores:

Toronto	Geo. McPhee	High single game	304
	" "	High two games	561
Ottawa	T. W. Grindley	High single game	281
	" " "	High two games	531
Niagara	G. G. Dustan	High single game	298
	" " "	High two games	530
Montreal	O. R. Evans	High single game	245
	" " "	High two games	445

Toronto took the lead in three out of four sections of the tournament, with Montreal, Ottawa, and Niagara each having a turn as runner up.

In reporting the results in December, the Niagara scores were omitted. Their inclusion would not have altered the results except that on the evening's average they were three points ahead of Ottawa and would have held third place. In the

December reports the score for high two games for C. H. Hodge should have been 573. This gives Mr. Hodge the record for high two games in the C.S.T.A. tournament, and he also holds the record for high single game at 305.

AGRICULTURAL OUTLOOK SERVICES

At the last two sessions of the Canadian Society of Agricultural Economics and at the 1932 and 1933 sessions of the National Conference on Agricultural Services resolutions were passed urging the establishment of an agricultural outlook service for Canada. The provinces of Nova Scotia and Saskatchewan are both issuing annually "Farm Outlook" publications as a guide to the planning of production and marketing.

Having in mind the need for a Dominion-wide outlook, the Executive of the National Advisory Committee on Agricultural Services, meeting in Toronto on November 22nd, 1933, appointed an agricultural outlook committee to arrange for an annual study of the agricultural situation. The personnel of this committee is as follows: J. F. Booth, Commissioner, Economics Branch, Department of Agriculture, Ottawa, Chairman; T. W. Grindley, Chief of Agricultural Division, Dominion Bureau of Statistics, Department of Trade and Commerce, Ottawa; J. E. Lattimer, Professor of Agricultural Economics, Macdonald College, Quebec; and J. Coke, Assistant Commissioner, Economics Branch, Department of Agriculture, Ottawa, Secretary. The method of preparing the report is described as follows in the Foreword:

"Early in January of this year an organization meeting was held in Ottawa to consider plans for the undertaking. This meeting was attended by representatives of the Federal Departments of Agriculture and of Trade and Commerce. On that occasion sub-committees were named to assemble the available information and to prepare preliminary reports dealing with various phases of the subject. These reports were later considered and accepted at a general conference held on February 8 and 9, at which time representatives of the Departments of Agriculture of British Columbia, Saskatchewan, Ontario and Quebec were also present.

Since this is the first Canadian report of its kind dealing with the national agricultural situation and outlook, its purpose should be briefly explained. It aims to present in concise form a review of domestic and foreign demand and competition and to analyse the factors affecting the supply of, and the demand for, particular farm products. Issued at a time when farmers are making plans for the ensuing year, or for several years, it is hoped that the report will be of some assistance. In this respect it is intended to supplement and to co-ordinate, rather than to displace, reports dealing with current information that are issued periodically by different departments.

While the facts disclosed by this survey of our basic industry give ground for some optimism concerning the future, the forecasting of economic recovery and of the trend of prices has not been considered the primary purpose of this work. On the contrary, it should be considered as an effort to present basic information and, within certain limits, to offer such interpretations as may be helpful to those engaged in farming.

The committee is desirous that full credit for the preparation of the various sections comprising this completed report be given to the officials who co-operated in their preparation, and that special recognition be given Messrs. T. G. Major, A. E. Richards, and P. E. Light for assistance in arranging and editing the manuscript."

The report of the committee is published under the title of *The Agricultural Situation*, and is issued by the joint authority of the Hon. Robert Weir, Minister of Agriculture, and the Hon. H. H. Stevens, Minister of Trade and Commerce. Copies are available on request from the Publications Branch, Department of Agriculture, Ottawa. A brief resumé of the report is given in *The Economic Situation* in this issue

of *Scientific Agriculture.* The preparation of this outlook has entailed a considerable amount of hard work, and the representatives of the several Federal and Provincial Departments are to be congratulated on making their report available at this date. In succeeding years it will be possible to develop a more extensive organization which will make it possible to publish the outlook at the opening of the year.

CANADIAN BACON NOW GRADED FOR EXPORT

The problem of the quality of Wiltshire sides exported to Great Britain has been before the Dominion Department of Agriculture for many years. With many exporters all grading according to their own interpretation of what the British market would absorb, and with the inability of any one exporter to guarantee a steady supply of any grade which might find favour in certain markets, the difficulties of building up a steady trade are obvious.

At the Imperial Economic Conference in Ottawa in 1932 Canada was allotted a quota in the British market which allowed for an enormous expansion in our trade in bacon. The opportunity carried with it the danger of a possible lowering of quality on the part of producers and exporters to meet the demands for quantity.

The whole problem was reviewed very carefully by Federal and Provincial officials and exporters at the National Conference on Agricultural Services held in Toronto in August 1932 immediately following the Imperial Economic Conference. At the Toronto meeting a resolution was passed requesting the Federal Minister of Agriculture to take such steps as were necessary to protect the quality of our export bacon and to popularize Canadian bacon on the British markets. It was intimated by the packing interests that they were ready to join the government in developing some suitable system of supervision of exports if this were deemed advisable. At the second National Conference on Agricultural Services held in Regina in July 1933 it was reported by the bacon committee that regulations for the grading of export bacon had been prepared and would become effective as soon as passed by an Order-in-Council. It has recently been announced that such a order was passed on the 16th of September 1933, and that the regulations went into effect on March 5, 1934. The following statement respecting the operations of the system has been issued by the Federal Department.

"Under these regulations the right to export Wiltshire sides of bacon directly or indirectly to the United Kingdom is by licence issued by the Minister of Agriculture upon application in writing. The applicant must satisfy the Minister that he can produce the bacon required by the provisions of the regulations, and all such bacon and the containers must be stamped, stencilled, or branded in a neat and clear manner with such data as may be required from time to time.

Each shipment of bacon is accompanied by a statement signed by the exporter showing the selections and grades and the number of packages. The statement also bears the signature of the inspector of the Health of Animals Branch, Dominion Department of Agriculture, who checked and supervised the shipment. The onus of grading properly will thus be on the exporter, and in the event of breach of any of the regulations the Minister of Agriculture may suspend or cancel the exporter's licence. There are three grades, A, B, and C.

By these regulations it is hoped that the principle of grading which has produced such fine results in building up Canada's export trade in fruit, dairy, and other agricultural products, will effect a similar advance in the Dominion's bacon trade. Although Canada's share of the British market increased in 1933 to 506,000 cwts. from 181,000 cwts. in 1932 and 49,000 cwts. in 1931, Canada's shipments represent only 5% of the British bacon imports from all sources, and it is to be remembered that Great Britain spends on an average $5,000,000 every day in imported food."

W. H. SPROULE HEADS O.A.C. DAIRY DEPARTMENT

Announcement has recently been made that Professor W. H. Sproule has been appointed Head of the Dairy Department at the Ontario Agricultural College. He has been acting in this position since the retirement of Professor H. H. Dean in September 1932, and has been with the Dairy Department since graduation in 1920. Professor Sproule is a native of Vankleek Hill in Eastern Ontario and during his college course served in the Canadian army and later became Assistant Agricultural Representative for Lambton County.

Professor Sproule has specialized in butter making and has done a considerable amount of experimental work of value to the creamery men throughout the province. Appreciating the value of the co-operation of all agencies interested in experimental work in dairying, he helped to organize two years ago the Ontario Dairy Research Council, on which there is representation from commercial organizations, the Federal Department of Agriculture, the Ontario Agricultural College, and others interested. Under his direction the Dairy Department will undoubtedly continue its development, becoming of even greater service to the dairying interests of the province.

NEWS ITEMS

A. T. Elders (Manitoba '24), formerly Assistant Professor of Agronomy, Manitoba Agricultural College, Winnipeg, Man., has been appointed Experimental Farm Assistant at the Dominion Experimental Farm, Brandon, Man.

W. S. Van Every (Toronto '22), has changed his address to 15 Trafalgar Street, St. Catharines, Ont.

C. A. Lamb (British Columbia '21), who has been taking post-graduate work at Cornell, has returned to his work at the Ohio Agricultural Experiment Station, Wooster, Ohio.

C. Shirriff (Manitoba '29), has changed his address to Box 50, Swift Current, Sask.

The General Secretary desires to express his sincere appreciation of the very substantial expression of good-will recently received from the officers and members of the C.S.T.A. locals throughout the Dominion. The fund raised relieves to a considerable extent the personal burden which was still being carried as a result of the unfortunate accident which occurred on the way to the Guelph convention. The carrying of this burden in addition to the added responsibilities arising out of the World's Grain Exhibition and Conference and the difficulties of financing the Society under present conditions have made the situation almost intolerable at times. The thoughtfulness and generosity of the Executive and members of the C.S.T.A. has given the General Secretary new courage. With some rearrangements which are taking place in the financing of *Scientific Agriculture*, and with the general improvement in business conditions, prospects for the Society now look brighter than at any time during the past two years.